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THE WONDER ISLAND BOYS

By ROGER T. FINLAY

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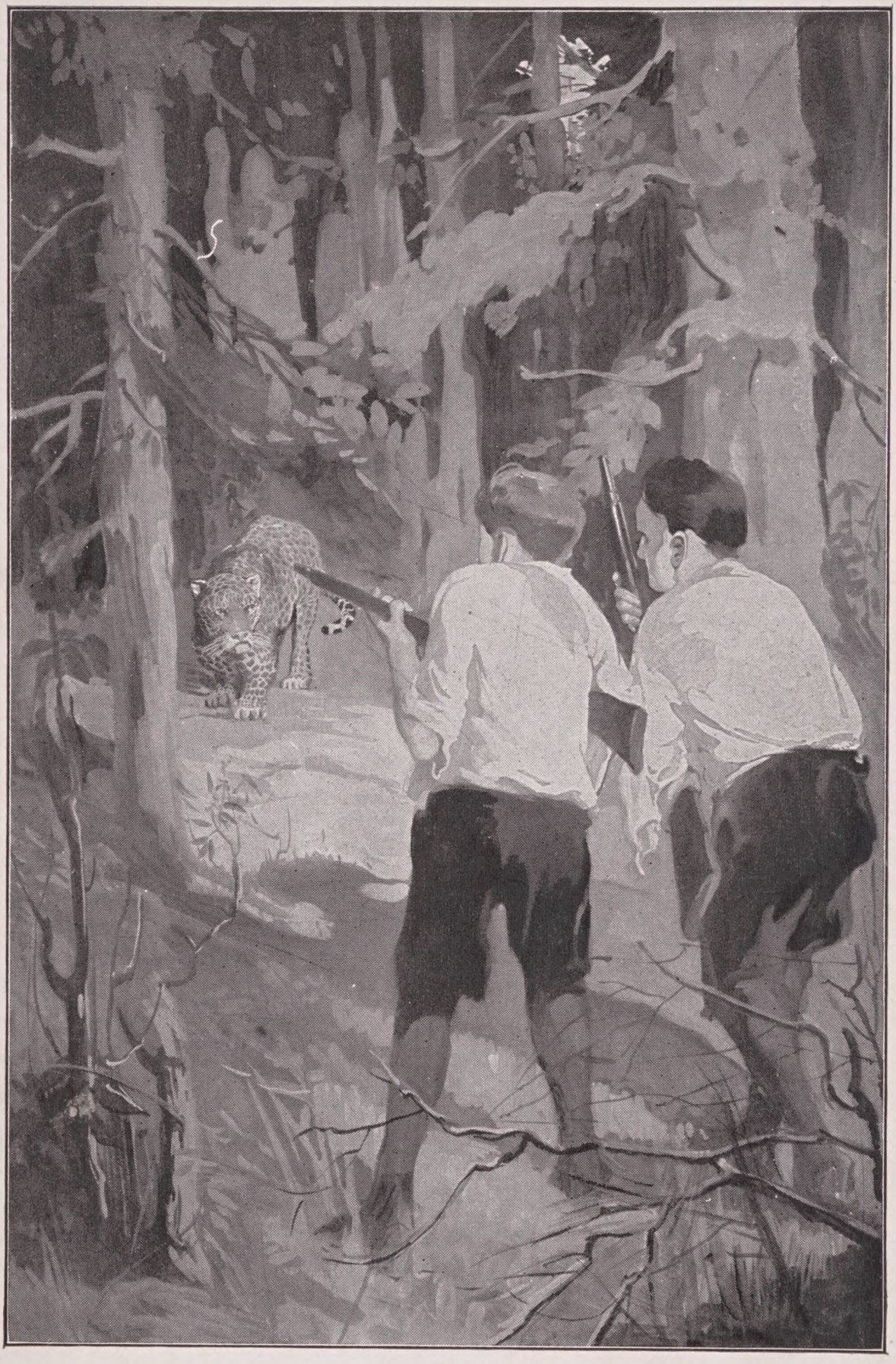
THE WONDER ISLAND BOYS

EXPLORING THE ISLAND



"Before they had gone 20 feet, a large leopard-like animal sprang transversely across their path"

[See p. 57]

THE WONDER ISLAND BOYS

EXPLORING THE ISLAND

BY

ROGER T. FINLAY

ILLUSTRATED

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EXPLORING THE ISLAND

CHAPTER I

THE FOURTH VOYAGE OF DISCOVERY

"I WONDER why the yaks are so wild and difficult to handle this morning?" said George, as he stopped the wagon and tried to calm them by soothing words.

At that moment Harry, who was in the lead, sprang back with a cry of alarm, and quietly, but with evident excitement, whispered: "There are some big animals over to the right!"

The Professor was out of the wagon in an instant and moved forward with Harry. "You would better remain with the team, George," was the Professor's suggestion.

George Mayfield and Harry Crandall, two American boys, attached to a ship training school, had been shipwrecked, in company with an aged professor, on an unknown island, somewhere in the Pacific, over four months prior to the opening of this chapter; and, after a series of adventures, had been able, by ingenious means, to devise many of the necessaries of life from the crude materials which nature furnished them; and they were now on their third voyage of discovery into the unknown land.

For your information, a brief outline is given of a few of the things they had discovered, of

some of their adventures, and of what they had made, and why they were now far out in the wilderness.

When they landed they had absolutely nothing, in the way of tools or implements. Neither possessed even a knife, so they had to get food and clothing and prepare shelter with the crudest sort of appliances.

By degrees they began to make various articles, found copper, iron and various ores, as well as lime-rock and grindstone formations. With these, and the knowledge of the Professor, they finally succeeded in making iron and copper tools and implements, built a water wheel, erected a sawmill, and eventually turned out a primitive pistol or gun.

During this time, however, they were interested in discovering what the island contained. The first voyage was on foot through a forest, where they saw an exciting combat between bears for the possession of a honey tree, and witnessed the death of one of them. By the accidental discovery of the honey tree they were supplied with an excellent substitute for sugar.

In the next voyage a large river was discovered to the south, which they named the South River. The second voyage was along that stream, until they reached a falls, where they were compelled to leave the crude boat which was made before starting on this voyage, and they proceeded on foot.

After a week's adventure in the forest they found a fire plot, which was the first indication that

the island was inhabited. As up to this time they had no weapons but bows and arrows, which they had made, they returned home hurriedly. On the journey they had the fortune to capture a yak and her calf, and subsequently became possessors of a small herd, two of which they trained. A wagon was built and a store of provisions gathered in. A crude machine was constructed to weave the ramie fiber, the plant of which they found growing on the banks; in addition they had success in making felt cloth from the hair of the yak.

After providing many of the things which were necessaries, and several samples of firearms, as stated, they determined to go on their third voyage of discovery. During the various trips several mysterious and inexplainable things occurred. First, the fire on the banks of the Cataract River, about fifty miles from their home. Second, the disappearance of their boat, which had been left below the falls in South River; and, third, the removal of their flag and pole at Observation Hill, a half mile from their home, during the time they were absent on the third voyage.

They were now on their fourth voyage, and the incident mentioned on the opening page of this chapter related to the first large animal they had discovered.

In a short time Harry and the Professor returned from the search. "We have lost them, but shall undoubtedly find them later on," was all he said.

The forest was still to the south of them, and to the north the sea was now distant fully three

or four miles, as the coast seemed to trend to the northwest, after passing the wild barley fields. The ground appeared to be more open and level, so a more southerly course was taken in that direction. Before night they emerged from the dense forest, which still continued to the right.

No stirring incidents occurred during the day, until night was approaching, when, on entering a straggling forest of detached trees and thick underbrush, George, who was in the lead, and acting the part of the scout, rushed back and held up a warning hand. The team stopped while Harry and the Professor quickly moved toward George.

"I have seen some orang-outans; come quickly."

Moving forwardly they could hear a plaintive cry, not unlike the wail of an infant. All stopped in surprise. The Professor was the first to speak: "That is a young orang. See if you can locate him."

As they moved still nearer the sound, there was a scampering of several orangs, and not fifty feet away was a pair of babies, struggling to reach the most convenient tree.

Harry pounced on the pair and caught one of them, which set up a vigorous shriek. The other, in the excitement, got too far beyond the reach of George, who, in his eagerness, was too busy watching Harry's captive to notice the other animal, and before he could reach the tree one of the grown orangs had reached the ground, gathered up the infant and again sprang up the tree.

"Give it some honey," said the Professor, laughing.

"What are the things good for, anyway?" asked Harry.

THE ORANG-OUTAN

"Of course, you are not compelled to keep it, but while you have it feed and treat it well."

"What does it eat?"

"Principally nuts and fruit, as well as vegetables. If properly prepared they will eat almost everything man eats, except meats."

At first, as a matter of curiosity, they restrained him, and as it was near camping time for the night, the Professor suggested that it would be well to make camp close to the tree which had harbored the orang family.

After a good supper the Baby nestled up in the mattress, and was sound asleep in fifteen minutes. When the boys arranged the mattresses for the night, Baby did not seem at all disturbed, and he slept peacefully until morning.

After breakfast no effort was made to deprive the Baby of its liberty, but no attempt was made on his part to leave the wagon. He relished the honey and the other delicacies, all of which were undoubtedly, a surprise to him.

The parent orangs were in sight on the trees beyond, but made no demonstrations, although they saw the young one crawling and swinging on and around the wagon.

You may be sure that the petting Baby got was enough to spoil any infant. Probably, the parents saw the affection lavished on it, or knew that it was not curtailed of its liberty.

When they again set out on the march Baby kept a firm hold on the mattress, or lazily swung from the cross bars of the wagon top. It was having the time of its life.

Before noon of the next day, Baby began to act strangely. It would jump first to one side, then to the other. Harry, who was in the lead, was called up, and the wagon stopped. The antics of Baby looked like fear. Before Harry reached the wagon the Professor and George heard a shot, and the next moment something struck the canvas top and rolled to the ground. It was up in an instant and sprang to the back of one of the yaks, before the Professor, who was driving, could realize what was happening.

George was off the wagon in an instant, and seeing the strange animal on the back of the yak, drew his gun, and two shots rang out almost at the same instant.

When Harry turned back, at the call of the Professor, he saw the animal in the tree, which was then alongside of the wagon, and without waiting to give a warning, had shot at it, the bullet going through its forelegs. The result was it fell, striking the wagon, rolled over, and then sprang to the back of the yak. George's nimbleness in jumping from the wagon, and running around, enabled him to get in a shot at the same time the Professor fired. Both of their shots took effect, and it rolled to the ground.

"What is it?" asked George.

"A wildcat; no wonder the poor Baby was frightened!"

"How did Baby, inside of the wagon, know of the cat?"

"The wildcat is the mortal enemy of the orang-outan. While they fear to encounter the grown

animals, they will attack the young, and the orangs seem to have the instinct of danger from that source born in them."

The Baby's nerves were unstrung with the din of the guns, and it was an hour before he could be calmed down. The wildcat was skinned, and it was days before the orang could be reconciled to the sight of the pelt or the smell of the animal.

"That is an instinct in certain animals. Nature has provided them with warnings of danger when their enemies are near."

"What a short tail the cat has," remarked George; "so unlike the tame cat."

"That, and the head, which is much larger and flatter than the common cat, as well as the shorter legs, show the distinguishing differences. Its color, as this one is, uniformly grayish-brown, with stripes running around the body, is a peculiarity found in the tame species, known as the 'tiger-cat,' to which they are the most closely allied."

Before nightfall fairly level ground was reached, and this being the third day, they judged their location was fully sixty miles due west of the Cataract. Far to the south and southeast the mountains could be distinctly seen, but the Professor did not think the ranges were very high.

In the far west the cloudy aspect of the sky prevented them from judging of the character of the land, but it had the appearance of mountains, as well.

"How far away are the mountains in the south, do you think?" asked the Professor.

"I estimate them at about five miles," was George's response.

"What is your idea, Harry?"

"I don't think George is far out of the way."

"Would you be surprised if I should put it at twenty-five miles, or more?"

"What makes you think so?"

"Appearances are always deceptive when you have nothing intervening to measure by."

"Is that the reason distances on water are always so deceptive?"

"Yes; have you ever noticed that you can judge distances better if the intervening landscape is rolling?"

"I think that is true in my case. But there is another thing I have noticed: When I am standing on the ground and looking up at an object, it never seems as far as when I am up there looking down: Why is that so?"

"That is simply the effect of habit, or familiarity. You are accustomed to look up at objects. The perspective, the altitude, and the appearance of the heights are natural things to you; but, when you are above, things below you have an entirely different perspective outline. Their arrangement is unfamiliar. Probably that is one of the reasons why we should always look upwardly in life, and not downwardly."

"But," inquired Harry, "is that the reason why some people, when at an elevation, like a tall building, or on a high precipice, say they feel like jumping down?"

"That is a species of paralysis, growing out of a

sense of insecurity. It is purely an unnatural sensation, that temporarily disorganizes the nervous system. I knew a man who, whenever placed in such a position, could not speak."

They were now on what might be called the table land of the island. A broad plateau, with frequent groves, and any quantity of young trees scattered about everywhere, gave a most pleasing view. During the fourth day of the journey occasional little streams, flowing to the north, were crossed, and in the forenoon they had to halt for two hours and camp during the heaviest rainstorm which had fallen since they came to the island.

On the fifth day a broad river was sighted, flowing to the north, and before noon the banks were reached. Its width barred their further progress, unless a raft could be made large enough to take the team across. This was considered a hazardous task, and the distance from home was too great to take the risk. It was a larger stream than South River.

CHAPTER II

THE MYSTERIOUS LIGHTS

The usual rate of travel did not average two and a half miles an hour, and while the first and second days were vigorous ones, they were not so much disposed to hurry up now, and were taking the trip more leisurely, thus giving more time to the examination of trees and plants and flowers, and to investigating the geological formation of the country. The new river was not, in all probability, more than seventy miles from the Cataract home.

Beyond, fully a day's march, was the mountain chain—not a high range, but an elevation which showed a broken skyline. The mountains below the South River did not now seem so formidable; and directly to the south they could see no ranges or hill elevations. To the north the sea might be ten or fifty miles away. The river flowed past them at the rate of about two miles an hour.

That evening, while sitting on the bank, Harry had an idea. "We made a mistake in calling our home river the West River. Let us call this the West, and rename our stream the Cataract River."

"Very well; as George does not object, the Geographical Society will please take notice, and make the change."

George was of the impression that to settle the question of the direction they should take in their

future explorations, was the most important thing to determine.

An entire day was spent in and about the vicinity of the river. New plants and shrubbery of various kinds were constantly sought for and examined—they fished and hunted; and on the morning of the third day it was decided to move on.

"We have not yet sighted any original inhabitants, and have found no signs of people living here; nevertheless, we had traces of a fire thirty or forty miles east of here. That is what puzzles me."

"I am in favor of following this stream to the north," was Harry's conclusion, "unless we make a raft and cross the river."

Harry's view finally prevailed, and at noon of that day they camped at the mouth of a little stream which flowed into the West River. Beyond was a forest, and on the opposite side of the West River the wood had all along been dense. At that point the trees did not come down to the stream, and there was considerable lowland between the river and the forest.

The Professor and George wandered up the banks of the little stream on a prospecting tour, as had been their constant practice. When they returned Harry knew something unusual had occurred from the excited appearance of George.

"What is it? Any animals?"

"No; only this." And George held up an arrow made of flint. The wooden portion of the arrow was really of good workmanship, and of hard, stiff wood.

"Where did you find this?"

"Not more than five hundred feet from here."

Harry looked at the Professor for an explanation, but he was silent. By common consent they now agreed upon making a more extended investigation of the vicinity for other traces, if possible. Within an hour Harry stumbled across the skull of an animal. This was not an unusual sight, as bones had been found at various places in their travels, but here was a specimen, lying on a rocky slope, with but little vegetation about it.

Types of Arrow-Head

Fig. 2.

"I should like to know what animal this belonged to?"

The Professor examined the bones critically, without venturing an opinion. "What is this?" were his first words. Directly behind the ear cavity was a split or broken cleavage in which they found a round piece of dark wood.

"Get the bolo, George; we may find something interesting here." With a few strokes the skull was opened, and embedded within the brain receptacle was an arrow.

"This animal was, as you see, killed by the in-

habitants of the island. I infer that there are several tribes living here."

The boys looked at each other in astonishment.

"Why do you think so?"

"This arrow is different in shape and in structure from the sample we found this morning."

The boys now noticed the difference.

"Do different tribes make their implements differently?"

"There is just as much difference among savages in the way they make their weapons and different implements, as among civilized people. Our customs differ; our manufactured articles are not the same; and sometimes the manner of using the tools is unlike; and the divergence is frequently so wide that it has been difficult in many cases to trace the causes and explain the reasons. Such an instance may be found in the Chinese way of holding a saw, with the teeth projecting from the sawyer. For years all tools and machinery made in England could be instantly recognized by those versed in manufacturing, on account of the bulk, as their tools were uniformly made larger and heavy, as compared with the French and American manufacture."

This conclusion verified the Professor's observation, and you may be sure that the new discovery gave an air of gravity to the camp which it did not have before.

"I also wanted to say to-day," was the Professor's last remark that night, "I am satisfied that there is no intimate intercourse between the different tribes on the island." The boys looked at

each other without questioning, as usual; but the next morning, as soon as George awoke, his first observation was: "I can't understand what makes you think that the natives of the different tribes do not associate with each other."

"Simply for the reason that the styles of the arrows differ so greatly. With them, as with civilized people, the intermingling of the races should tend to make their tools and implements alike."

The next night, after the evening meal, they sat in the wagon until late, discussing their future course. It was now fully nine months since they left home. The thought that their parents and friends would consider them lost was the hardest thing to bear. Did the boys ever get homesick? I need not suggest such an idea to make it more real than it was to them. With beautiful home surroundings, loving parents and brothers and sisters, absence, uncertainty; the fear that they would never again be able to return; danger all about them; the belief that perils still awaited them, which fears were now, in all probability, to be realized, all these things did not tend to produce a pleasant perspective to the mind.

But the Professor was a philosopher. He knew that the human mind craved activity. If it could not be exercised in a useful direction it would invariably spend its energies in dangerous channels. He knew this to be particularly true of young people.

Boys are naturally inquisitive. Their minds are active, like their bodies. They must have ex-

ercise; why not direct it into paths of usefulness, where their accomplishments could be seen and understood by the boys themselves.

That thought is the parent of the manual training system, where the education imparted comes through the joint exercise of brain and muscle. Boys resent all work which comes to them under the guise of play; and all play which is labeled "work." But when there is a need for a thing, and the inquisitive nature of the boy, or his mental side, starts an inquiry, the manual, or the muscular part of him, is stimulated to the production of the article needed to fill that want.

The Professor did not force any information upon the boys, as will be noticed. It was his constant aim to let inquiry and performance come from them.

Could anything have been more stimulating or encouraging than the building of the water wheel, the sawmill, or the wagon? See what enjoyment and profit they derived from it. Thus far they had not given their time and the great enthusiasm to their various enterprises because of the money returns. Do you think it would have made their labors lighter, or the knowledge of their success any sweeter if they had been paid for their work?

The "Baby" went to sleep early, as was his custom now, and the boys and the Professor sat up later that night than usual, talking over their condition, and the situation as it appeared to them. The day had been exceedingly warm, following the rains.

Harry, who was seated facing the river, sud-

denly sprang up and excitedly grasped the Professor's arm, as he pointed across the river: "Look at that light!"

There, plainly in the distance, was a light, not stationary, but flickering, and, apparently, moving slightly to and fro.

"It seems as though it is at the edge of the woods," remarked George. The distance was fully a half mile away.

"It can't be possible that people are over there," said Harry, not so much in a tone of inquiry as of surprise. "How far do you think it is from here?"

"Probably one-half mile, or more. We might be able to learn something if we should fire a gun," was the Professor's reply.

The boys were naturally astonished at the boldness of this remark. Other lights now appeared, some dim, others brighter. The firing of a gun seemed to them a most hazardous thing to do, but no doubt the Professor had a reason for making the suggestion.

It was quite a time before either of the boys responded to this proposal. In their minds it was a daring enterprise.

"If we should fire a gun the noise would likely startle them, and the first impulse of the savages would be to extinguish the lights."

George, who had the spirit of adventure more strikingly developed than Harry, was the first to concur.

"I am going to try it at any rate; we might

just as well know what we have to face now, as later on."

"So you are really going to shoot?" said the Professor.

"If you so urge it, yes."

"Then let me suggest what to do. All savages have a keen sense of direction. It is one of their chief accomplishments. You and Harry go back, up the river, a quarter of a mile, or so, and take with you one of our coverings. Then shoot behind the blanket, so the flash will not be seen, and I will remain here and watch the effect."

There was no delay in their preparations. Within fifteen minutes the shot rang out, and almost immediately thereafter every light had disappeared. The boys were also keen enough to note the extinguished lights, and returned to the Professor in a hurry.

"The disappearance of the lights is not conclusive evidence that human beings were there. It might have been a mere coincidence."

"Coincidence! What do you mean by that?"

"Did it not occur to you that the lights might be natural phenomena?"

"Of what?"

"Of phosphorescence."

"Do you mean 'will-o'-the-wisp'?"

"It is sometimes called by that name. It is caused by decaying vegetable matter, and exhibits itself in the form of gases of phosphorus, which appears to burn, but does not, like the vapor which is produced by rubbing certain matches in the dark."

"But how do you account for the disappearance after we shot?"

"I thought they might have disappeared naturally, after you fired, and, therefore, said it might have been a mere coincidence."

This explanation was not a satisfying one for the boys, and the Professor did not place much faith in it, for the following reasons:

"I believe it is our duty now to keep watches during the night, which we can do by turns, so that the sentinel will quietly awaken the next one in his turn, or both in the event of any unusual happening; and furthermore, we should make an early start in the morning."

George was the first watch, and, by agreement, Harry was to be the next, in two hours, for the second period. Before that time passed Baby was very restless, and George tried to soothe him; but before long he began crying. A lusty orang, however small, in a still night, makes an awfully loud noise. The boys never heard anything as loud and as frightful as that cry appeared to them.

All were awake, of course, but the Baby refused to be quieted for fully a quarter of an hour.

"Don't you think Baby's cries will direct the savages to us?"

"It is not at all likely. The savages have no doubt heard the cries many times. It is your imagination which is playing you tricks. Do you suppose the savages know we are here and have a captive orang?"

During the rest of the night they took sleep in

snatches, and morning was long in coming. Harry had busied himself in getting a hasty breakfast while the others slept, and Baby was up leaping around nervously, and springing from branch to branch on the adjacent trees.

Having finished breakfast, the yaks were yoked, and before the sun was visible they were on their way to the north, as fast as the yaks could travel.

The whole camp partook of watchfulness now. Every hour and every mile they scanned the landscape, and, for further precaution, kept away from close proximity to the river bed. That was not a safe route, as enemies on the other side of the river would have an unobstructed view, whereas by traveling inland, but within sight of the river, they could still view the banks of the stream.

"The scout who leads the way must go a certain distance, then make observations in all quarters. He must take particular note of objects which afford places of concealment, and the eye must be alert enough to observe every undue movement in limb or leaf. Sound is one of the things he must cultivate. A noise of any kind should be analyzed. A scout once told me that on one occasion during the war, his life was saved because he saw one limb of a tree move more than an adjoining one. At another time, in trailing through a forest, he saw a leaf on the ground, differing in color from those around it. In walking along he had noticed that some of the leaves he overturned had the same color, and inferred that as no wind had been blowing, and all the trees were bare, something

must have turned the leaf, and subsequent events confirmed his reasonings."

The boys quickly learned their lessons. Each knew that every step forward meant an entrance to an unknown world.

CHAPTER III

THE BEAR FIGHT

During the day, following the night when the mysterious lights appeared in the lowland directly to the west and beyond the river, they passed through several dense forests. George, who was in the lead at this time, emerged from the thickest wood into a rather open plain. He saw the river make a long circular sweep, and directly ahead noticed a coast line of steep hills which marked the shore of the river on the opposite side.

Harry and the Professor, who were behind with the team, had not yet reached the clearing. As George passed into the open space he saw an animal cross his path, and without waiting to inform the others, he shot. This alarmed Harry, who was out of the wagon without waiting for any word from the Professor. Immediately after George's shot was heard, they plainly heard another from the direction of the river ahead of them. The Professor, too, jumped from the wagon and followed Harry. George fired a second time, and another shot came from the river. Harry turned and looked back at the Professor in amazement.

"What can that mean? Did you hear four shots?"

"Yes; run ahead, and find George."

In a brief time both boys returned. "George says he did not hear the shots from the river."

"They were as plain as your own."

George did not know how to explain it. The Professor moved forward. "Let us get out into the opening."

As they reached the clearing beyond the wood, and the Professor saw the steep bluffs beyond, he laughed, and looking at the hills, said:

"That is where the shots came from."

His amusing smile was reassuring, although his words were not.

"That bluff over there is about 2,000 feet from here. We had better find out what he is doing there."

"Two thousand feet; and somebody there!"

"I did not say somebody was there, but that the noise of the shot came from that place."

"Do you think it was simply an echo?"

"Undoubtedly; didn't you hear Baby's cries repeated?"

"But how do you know that the hills are 2,000 feet away?"

"Sound travels at the rate of 1,040 feet per second, and I made a mental calculation that it took four seconds for Baby's cries to come back from the hills. In that case the sound had to go to the hills and back again, and it would, therefore, take two seconds to travel one way. Do you understand?"

"Oh, yes; that is perfectly clear."

The land now became more rolling, and was occasionally broken by ravines; and sometimes they had difficulty in getting their yaks and wagon across and over the rough ground.

Fallen trees were numerous; there were little mounds here and there, made by the remains of uprooted trees, which had long ago decayed, all of which made their traveling laborious and slow.

Here wild animals became more abundant, and wild game was found on every side. Several good shots by the boys replenished their larder with bird meat.

"See that bear!" cried Harry in great excitement.

The boys, as well as the Professor, were out with their guns at once. "Follow him up quickly now," and the Professor could hardly keep pace with them. The bear did not seem to be greatly frightened, and when Harry, who was ahead, stopped and aimed his gun for a shot, he was less than a hundred feet away. The shots from the two boys came close together, and bruin stopped in surprise, then, with a snarl, turned around and in a lumbering, shuffling movement started for the boys.

If either shot had taken effect it was not noticeable. The boys turned to run, one going to the right and the other to the left. This did not seem to disconcert him in the least, as he went right on. He had seen the Professor, who stopped and sprang to one side and bringing up his gun awaited the charge of the bear.

The boys, encouraged by the tactics of the bear in avoiding them, turned again, because they now appreciated that the Professor was in the bear's path.

"Don't shoot, boys; let him come nearer."

"When he came within fifteen feet the Professor fired, and the boys also shot. The bear reared up, gave a terrific growl and again shambled forward, this time making a beeline for the wagon. This was too much for the yaks; they

Figure 3

THE BEAR

turned, almost upsetting the wagon, and Baby commenced to shriek in the most approved fashion.

Neither George nor Harry could wait any longer. They followed and rushed past the Professor, who now had the only loaded gun.

"Take this, Harry; your guns are not loaded."

Harry turned and grasped it and without stop-

ping went in pursuit. Before he had reached the former location of the wagon the animal ran into a tree, which threw him back on his haunches, and after several efforts to raise himself, fell over on his side.

The Professor's shot had entered his left eye, but the vitality of the animal was such that he ran nearly a hundred feet before it took effect.

The yaks were soon rounded up. It is a wonder that more damage was not done. Aside from the displacement of their bedding, and the ditching of some of the cooking utensils, everything was found intact.

"That was a rather ill-advised adventure on our part. We should have guarded our supplies; but I was as much to blame as you were. We must be more careful in the future."

On every side the rough character of the land was more apparent, and it was becoming more and more difficult to find tracks which were suitable for the team.

"This matter of going further with our wagon is now getting to be a serious problem. I think we should turn to the right and move in the direction of home, or direct our course southeast toward the mountains on the other side of South River."

"I think we have discovered enough on this trip," was Harry's conclusion.

George assented, so that on the twelfth day of

their journey the yaks were directed towards home. For two days the travel was southeasterly, through the most broken and tortuous paths, crossing innumerable small streams and rivulets on their course. During this troublesome part of their journey the weather was stormy, with numerous rains, some of them so prolonged as to prevent traveling for hours, so that they made less than twenty miles during that time.

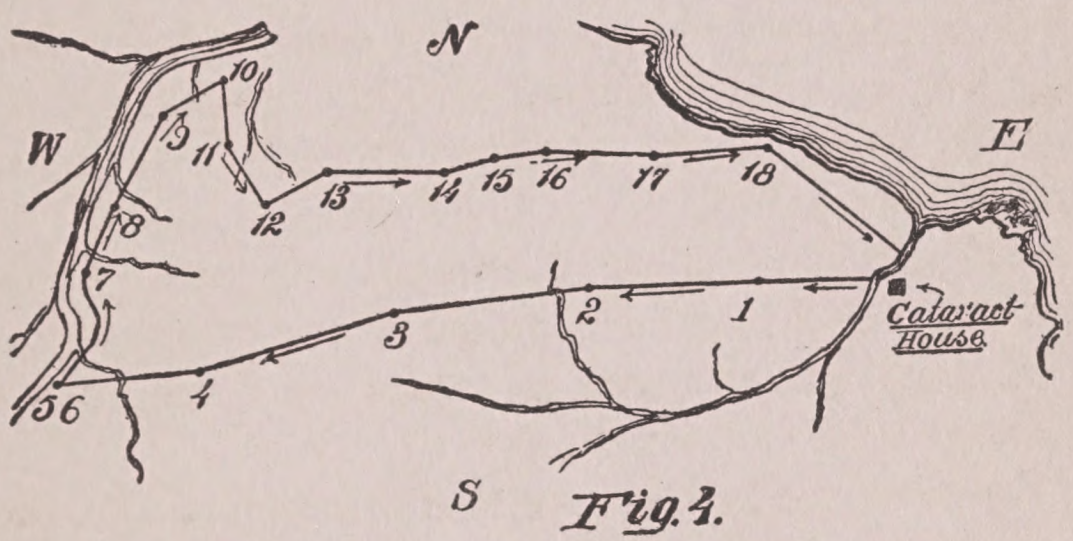


Fig. 4.

Diagram of Their Trip

On the third day, however, the ground became more level and less broken, the sun appeared, and they felt happy at the thought of getting back again.

Thus far in their wanderings they had kept their reckonings, as well as they could without instruments, and that evening the chart was again consulted, as usual. The drawing (Figure 4) shows how it looked with the course of their journey.

When they started from the Cataract home at nine o'clock in the morning, they made an observation of the sun, using a vertical pole so as to get the exact direction of the falling shadow. A distant object was then selected, a prominent tree, as far off as possible. The Professor had prepared an adjustable bevel square, which was simply two legs hinged together at one end, by means of a set screw, like a compass.

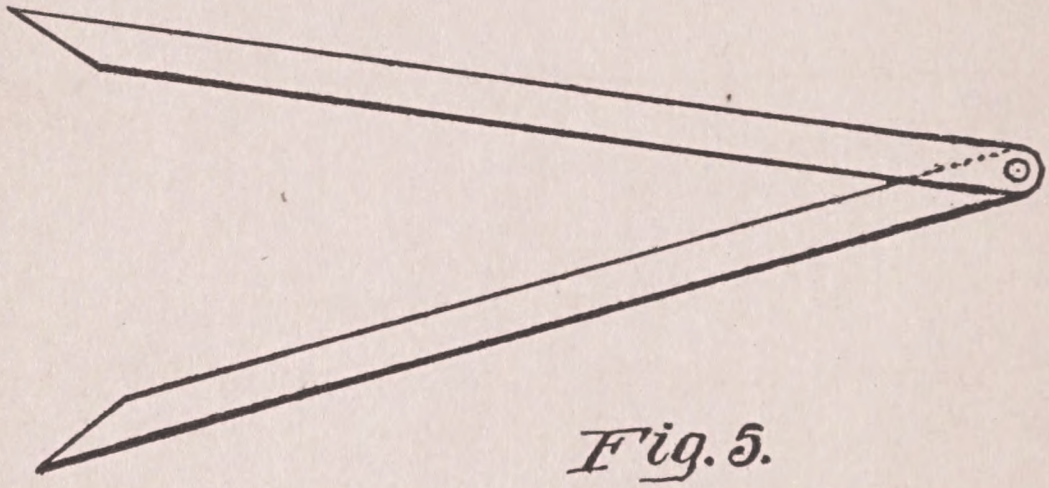


Fig. 5.

BEVEL SQUARE

"Now, boys, I want to show you how we can make a fairly good chart simply by the use of this adjustable square, and this will also be of service to us in measuring heights of objects, as well as directing our course. It is now nine o'clock, and you will see that our pole (A) throws a shadow to the southwest. Supposing now, we direct the first leg of our journey to that large tree (C), to the west of us. If, now, we put one leg (D) of our rule along the shadow line, and the other leg (E) along the sight of the line (F), which goes to the tree, we shall find that the dis-

tance across between the ends of the bevel square is just two feet. It happens in this case that the tree (C) is due west from our observation point; so we have at nine o'clock each morning a means whereby we can always determine the true east and west."

"But supposing we lose our reckoning during the day, on account of cloudy weather, or by going through the forest, where we cannot make observations?"

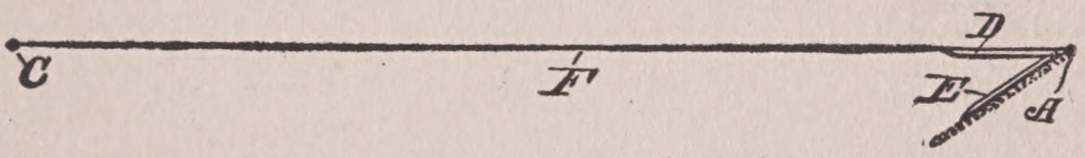


Fig. 6.

SIGHTING THE DIRECTION

"We could, probably, travel an entire day in one general direction, without being more than a few miles out of our course, north or south, and our direction immediately made out the next day."

"Wouldn't it be a good idea to prepare angles at different times of the day, in the forenoon and in the afternoon?"

"That is the proper thing to do, so as to enable you to make observations from the angles at all times. A chart could then be made from that which would show at a glance what the value of each angle is."

"We shall certainly have to do that; but what interests me as much is, to know how far we have traveled. Can we also tell that by the sun?"

"Yes; but to do so will depend on the accuracy of the observation. For the present, with only a

single instrument, the bevel square, we must be content to make our calculations exactly at mid-day, when the shadow points due south. Or, in the northern hemisphere, when the shadow points due north. I want you, in the meantime, to think over that problem, as it is a very interesting one, and we will take it up when we are not so tired."

CHAPTER IV

THE DISAPPEARANCE OF THE YAKS

It was a relief to get on fairly even ground again, where it would not be necessary to make turns and twists around all sorts of obstructions, to say nothing of ravines and water courses. On the evening of the fifteenth day, calculations showed that they were halfway back from the point farthest west, but they still had no knowledge of their distance from the sea, which undoubtedly was to the east, or, possibly, northeast. West River flowed to the north, and all the streams crossed flowed north or northeasterly, how far, it was impossible to say.

Two days afterward the scene changed somewhat. There had been little wind during the journey thus far; but now breezes sprang up for two successive days, at about four in the afternoon, which came from the north.

"I think the sea is not far away."

"Why do you think so, Professor?"

"Did you notice the warm breezes this evening, and also last night at about the same time?"

"Why should the breezes from the ocean blow warm winds to us at this time of the year when it ought to be cold?"

"It is not at all likely that the breezes are any warmer than at other times of the year. Heat is merely a relative matter. We feel the difference of

the wind temperatures principally for the reason that when the vast body of water in moving ocean streams is giving off its heat, it imparts it to the atmosphere and modifies it, so that as it sweeps over the land it is warmer than the natural temperature."

The following day, late in the afternoon, they caught the first glimpse of the sea, and it was welcomed. A camp was made for the night in the open, and with an early start next morning the explorers reached the last hill to the west of the cataract.

When they arrived home, which was not without considerable misgiving, owing to their long absence, they were overjoyed at finding everything at the house in perfect order, but their yaks were missing.

This was, at first, a sore grief to them, especially to George, who considered it to be a personal loss. Milk was a luxury, as well as a necessity, to him. The team was now all that remained of their herd.

"It is strange we did not see any of them on our journey."

It was a surprising thing to see their water wheel in motion, although they had taken considerable pains to push the wheel back so the blades would not be in contact with the water. It was found that the Cataract River was much swollen with the rains, so that the water had come into contact with the wheel.

As the team was now the sole reliance, so far as the herd was concerned, the Professor suggested that they should thereafter keep the team

within the enclosure, so as to prevent their straying, as they might, in the absence of their fellows, try to escape.

The present house, which had been built since coming to the Cataract, had originally only one room, and two of the sides were formed, as stated, by the walls of the right-angled rocks, the room being about ten feet square.

After the water wheel was built and put in and the sawmill erected, they were enabled to get lumber, and an extension twelve by fifteen feet was put up, to be used as a sleeping and living room.

A small addition was also added, which was converted into a kitchen, so that the original enclosure could be used as a storeroom.

A sort of roadway passed the new addition, and beyond was the Cataract, not fifty feet away. Directly below the Cataract another building was put up, in one end of which was the sawmill, and at the other end was a sort of shed in which they had put up a furnace, blacksmith shop, and a kind of primitve foundry.

Within the workshop work was done during the rainy weather, and it was made as comfortable as possible.

They were now back, ready to take up active life again. Not that the past nineteen days were inactive ones. By no means; but they loved the work which every day had brought to them in the past, and were happy in the thought that they were accomplishing things of the greatest value to themselves. They were really tired, and for a few days did little active work.

"Do you think we have accomplished very much on our trip?" was George's inquiry the evening of their arrival.

"We saw a light, didn't we?"

The boys laughed, when they saw that the Professor said it with a broad smile. They had no doubt, but he wished to convey the impression that they had seen a light, just as many others had, without being able to understand it. George saw the point at once. "I hope we may be able to profit by it. But, really, how much more do we know than we knew a month ago?"

"The West River, the bear, the wildcat, the Baby; why, you had entirely forgotten him and his cute ways. We learned that there are, without doubt, savage tribes on the island. I am inclined to think the trip has taught us something."

The Baby was an interesting little chap. He would sit up at the table with innocent blinking eyes, and gravely imitate the motions of eating, especially if there was something sweet in sight.

That night a startling noise was heard, made by the unmistakable tramp of animals passing their home. Harry was the first to open the small port, which served as a window.

"Hurrah for our yaks!" There they were, back again, with two additional calves. The next morning they were contentedly lying down outside of the enclosure which held their team.

Didn't "Baby" enjoy the milk! So did the boys. The cattle had not strayed away far, but merely found a better feeding ground. The barley field had been exhausted.

"If there is anything I missed on the journey, it was the clock. I don't like guessing at time," was George's comment, after they had fully gone over their experiences on the trip.

"I suppose," said Harry, "we can make watches, but they will be rather cumbersome, because our tools are not very delicate. What do you think, Professor?"

"That is for you to decide. I am of the opinion that as we have a pretty good clock, and as it is susceptible of being nicely regulated, we could put in our time more profitably in doing some other much needed work."

"What is that? I am willing to do anything?"

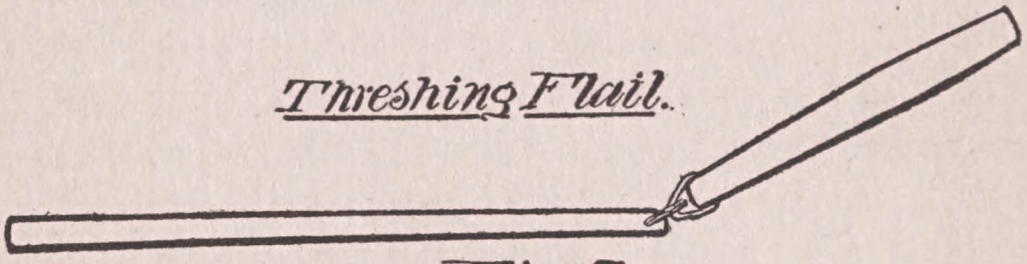
"We have some hides that need tanning, and the fresh bear pelt must be cured. As our herd of cattle has increased we might slaughter several of them, so that we can dehair the pelts and tan them all at the same time; then we need some contrivances to enable us to determine the location of our island; and also to afford a means to measure distances in traveling, because, I presume, you are just as anxious as ever to know what we have on the island."

There was a hearty assent to this view of the situation.

"I want to do everything we can to learn about our surroundings," was George's response; "and I would like to have the fire, and the mystery of the boat, and the flagpole cleared up."

The thing which most interested Harry after their return, was the disposition of the barley which they had harvested before the last journey

was undertaken. This was welcomed by the Professor as a necessity. Accordingly a level floor was provided, on which was spread a thick layer of barley stalks, and this was beaten with flails. A flail is simply a piece of wood about the thickness and length of a broom handle. To this was attached, by means of leather strips, a club, not unlike a baseball bat, so the bat portion swung on the end of the handle, and in this manner the barley was threshed out.



Threshing Flail.

Fig. 7.

Before the invention of the threshing machine this was the universal method of threshing, although it was also customary to tramp it out with horses, which were driven over a thick layer of the straw hour after hour.

In one day they threshed out five bushels; beautiful golden grain. The boys who had often seen wheat and oats threshed out, never appreciated grain as they did their own, acquired in the manner this was.

The grinding-stones, which they had previously made, were then set to work, making the meal, or flour, as they preferred to call it. Heretofore flour had been a luxury, and there was a longing for it, so it was decided to make up the first batch of bread.

You may be sure that the Professor did not object to activities in this direction; and they had long ago learned his peculiarities, particularly not to venture any information voluntarily, so the boys concluded to make bread on their own knowledge. They had often seen bread made.

"All you have to do is to mix up the flour with a little water, put some rising in it and let it stand until it raises and then bake it."

"That's all well enough, Harry; I suppose we can do all that, but where shall we get the yeast?"

"That's so; yeast is necessary; I suppose we shall have to see the Professor, after all; but hold on; I have seen sour milk used, George."

"So have I; but I think mother used something else with it."

"Well, there we are; who would think we could have trouble with such a simple thing as making bread?"

"The Professor came smiling. You want to make bread, and the only thing that troubles you is to raise it so it will be light?"

"Wouldn't it be bread if you didn't raise it? You know the Jews used unleavened, or unraised, bread."

"But we want regular bread, of course, and we want to know what to use to raise it with."

"I don't see that you particularly need anything."

"Why not?"

"If you let the dough stand in a temperature of between 90 and 120 degrees for a certain time, fer-

mentation will take place, and it can then be baked."

"But why should it ferment?"

"Bread raising is merely fermentation. All flour is largely composed of starch. The high temperature, of 100 degrees or over, causes the starch to turn first into sugar, then into alcohol and carbonic acid, and the gases thus formed force their way up through the dough, causing it to swell, as you have often noticed."

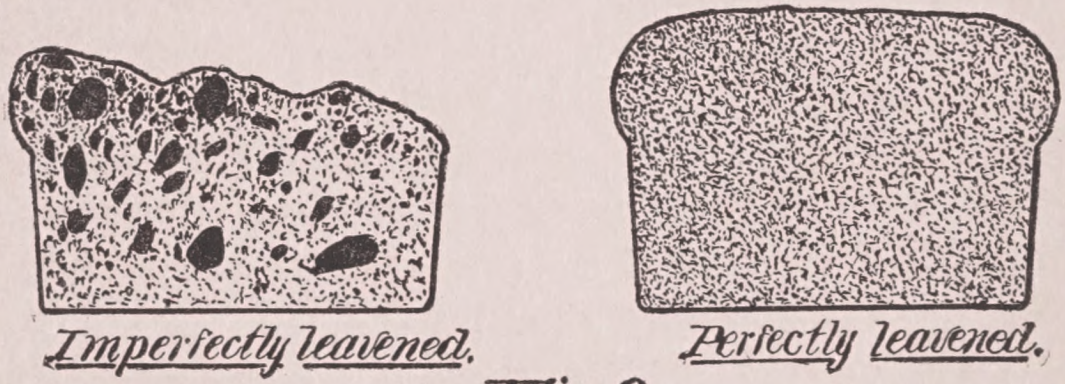


Fig. 8.

SAMPLES OF BREAD

Without further instructions the boys began the making of bread. Shortly afterwards the Professor appeared laughing immoderately.

"Come and see the Baby."

The boys were out in an instant. The Baby was in the storeroom adjoining, and discovered the honey pot. It was a "sight." He sat there, both hands and arms covered with honey, blinking innocently, and licking his fingers and arms with the greatest joy imaginable.

"You little rascal, you are getting too fat now,"

was George's greeting; but Baby didn't mind. He knew George by this time.

The bread raised, but it, too, was a "sight." It was full of holes and at some places the bread had no appearance of having "come up," which is kitchen parlance for unraised bread.

"What is the matter with it, Harry?"

"Did you work it before you put it into the oven?"

"I forgot that."

When the Professor saw the sample he divined the trouble at once.

"Of course, you have to work it, for the reason that "working" distributes the gases through the mass. I think you made the mistake in working it and then putting it into the oven immediately."

"How long should it stand after working?"

"That depends on the amount of carbonic gas which is developed. When it first raises the gas forces its way through the dough irregularly, and by then working it the gas is broken up and distributed evenly, so that if the mass is allowed to stand after the second working every part of it will be leavened. When it is then put into the oven, the heat at first causes a more rapid expansion, or raising, of the dough, and as the heat increases, fermentation is stopped, and the baking process sets the dough. The result is tiny little holes throughout the bread, where the gases were."

"But why do they use yeast if it can be done without?"

"Because it makes the raising process easier, and more positive."

"Is it the carbonic acid which makes some bread sour?"

"Yes; sour bread results if the fermentation is continued too long."

It was George's custom each day to watch the movements of the yaks, because it was through them that they learned of the barley field which was such a source of usefulness to them. One day while out on an expedition of this kind, he wan-

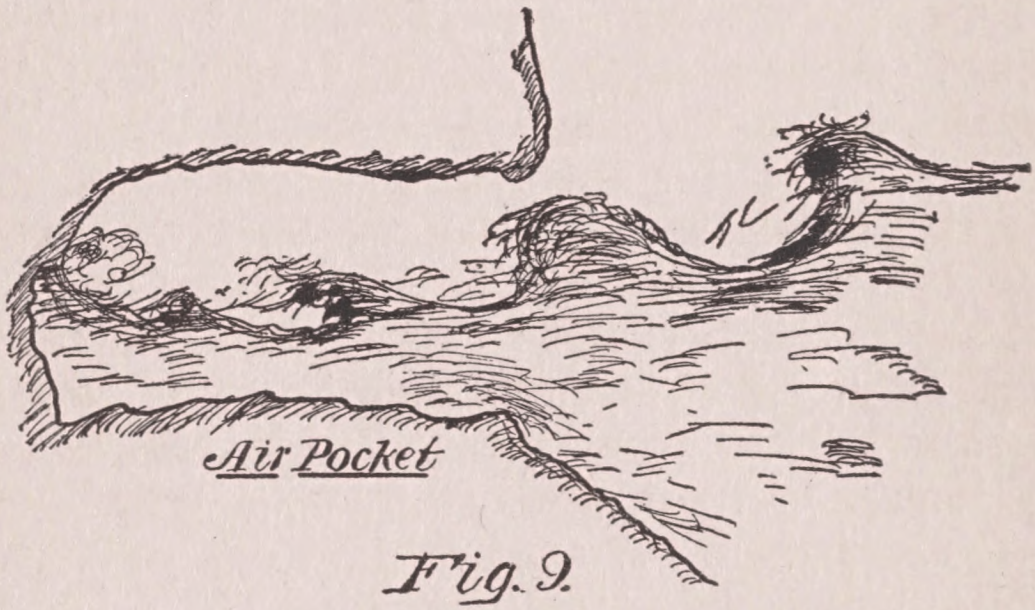


Fig. 9.

dered down to the rock cliffs, probably five hundred feet west of Observation Hill, this hill, it will be remembered, being close to the landing place when they were cast on the island. The sea was heavy and the tide coming in. He could not help reflecting, and his home, his parents, and his beautiful life there came up to his inward vision. The dreary pounding sea made him homesick, and for the first time he burst into tears. But George was a brave boy. He knew that crying was useless, and felt a little ashamed of himself.

His reflections were not long, however. To his left he saw a peculiar sight. At every inrushing wave there was a report like a cannon shot, followed by a tremendous stream and spray of water, which was shot out to sea high up above the waves.

This was an extraordinary sight to him, and unexplainable. The story was related to the Professor that evening.

"That was an air pocket in the rocks."

"What is an air pocket?"

From your description it is probably a large cave, so situated in the wall of the cliff, that at a certain period the waves will entirely close the mouth. When the wave dashes up against the cliff and closes the mouth of the cave, the water tries to enter the cave. In doing so air is compressed in the pocket, and when the wave again starts to go out to sea, and the pressure is partly taken away, the compressed air explodes, so to say, and shoots out the water into a spray, and also causes the noise you heard."

"How much can air be compressed?"

"It is not known definitely how far. It has been compressed to less than one-eight-hundredth of its bulk. It is the most elastic substance known."

"Isn't water compressible?"

"No; if it had been compressible you would not have had that exhibition at the air pocket."

CHAPTER V

AN EXCITING HUNT

"WHAT is that rocking?" cried Harry, jumping out of his couch, one night.

The Professor was awake and had noticed it.

"Probably an earthquake."

The rocking continued for several minutes, and then gradually subsided. They boys were so excited that sleep was out of the question, for the time, besides the shaking might again recur at any moment.

"Do you think there is any danger, Professor?"

"It is impossible to say what will happen when these symptoms in the earth's crust take place."

"Are there not some instruments which indicate the extent and possible dangers of the quakes?"

"There is an instrument called the seismograph, which records the vibratory movements of the earth, and also locates the distances at which the shocks are from the observer, but there is nothing to indicate what the extent and probable dangers are."

"Is it true that the interior of the earth is in a liquid state?"

"Such has been the theory for many years; but it is now believed to be a solid—a body with a density five and a half times greater than water."

"If that is the case, why is it that the molten metal flows out of the volcanoes?"

"There may be fissures in the earth, or portions less dense than others which, by the general disarrangements of the adjacent parts, and by the enormous pressure exerted by the force of gravity, are contracted, and the movement causes such friction and intense heat as to liquefy the rock. In doing so a large amount of gas is evolved, the movement of which causes the disturbance of the earth's crust, which manifests itself to us in the form of earthquakes. At the same time the confined gases seek an outlet, which they find at the weakest part, and the volcanoes spout forth the lava, flame, and gases. There is an undoubted connection between earthquakes and volcanic eruptions. Earthquakes usually precede volcanic action. This internal combustion is going on at all times, and is only more violent at some period than at others. The lava in the Crater of Stromboli has been in a liquid state for more than two thousand years."

"Before we left home I saw in a paper that some scientist described the kind of rock and other matter which was seven miles down in the earth."

"Was anyone ever down as far as that?"

"No; a little over a mile is as far as man has actually penetrated the earth."

"Then, I should like to know how geologists can tell with any certainty what the rock is like several miles down?"

"That is known just as positively as though a hole had been dug down that distance."

"I don't see how that is possible."

"I am going to make you a sketch which you can examine at leisure, that will show how he knows. Assuming that the earth has a crust—that is, the outside or cooled part, let the first sketch (Figure 10) represent this crust, before the mountains and valleys were formed. The slightly curved horizontal lines merely represent the different layers of the crust, such as rock, clay, coal, slate, and the like. When the cooling process took place the earth grew smaller within, so that the crust was forced together."

Fig. 10.

NORMAL CRUST OF THE EARTH

The second sketch (Figure 11) shows this crust forced together, so that when the upheaval took place, two mountain ranges, A and B, were formed, with a valley (C) between them, and the broken lines (D), where the crust separated, were exposed, and by that means examinations can be readily made way down into the crust, without ever leaving the surface of the earth."

As it was understood that the boys should take at least a day each week for hunting, particularly since such sport would develop expertness in the use of their weapons, an early start was made on the day selected, which was within a week of the time they returned home.

Ever since the disappearance of the boat left at the falls in South River, there was some anxiety on that score. It was a frequent topic of conversation, and after they left home it was by a mutual impulse that they wended their way south, taking a trail which was now familiar to them.

"See here, Harry, I should like to go to the place where I discovered South River, and where I had the experience with the snake and the strange animal, which frightened me so."

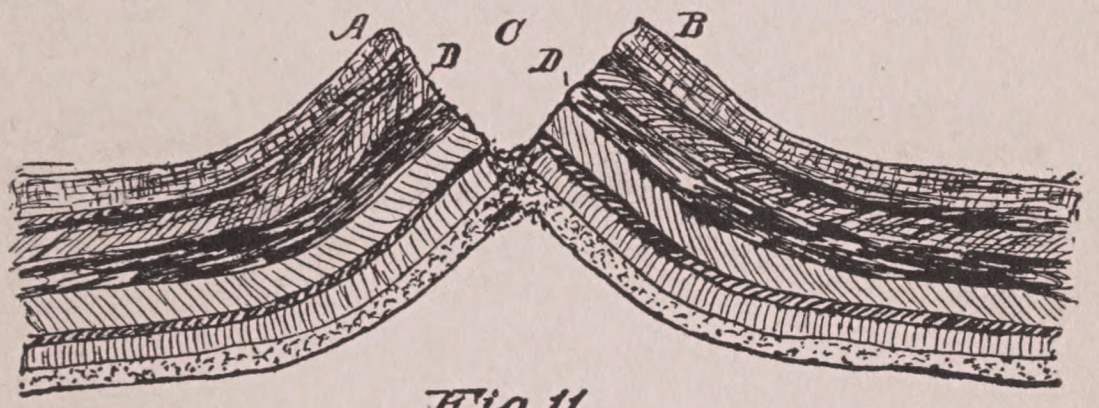


Fig. 11.

MOUNTAIN UPHEAVAL

"Then we must go to the left, because, you remember, you came up between these hills, and crossed the stream where I found you."

It was about three miles across from the Cataract house, but less from their original home. When they reached the river the surroundings were very much unlike anything George had seen before, and he could not identify the place where the ramie plant had been found.

The ocean could be seen plainly from their position, and George thought they were too far east, which proved to be the case.

"Here it is, Harry; here is a low place, and you

can see the ramie plant all about here. I am sure of it."

"Is this the place you lost the hatchet?"

"So I did: I'll show you the place." But he failed to find the hatchet. Subsequently Harry stumbled across it, but it was found some distance from the place where George declared he lost it.

"Let us try to cross the river. We can do it if we find a couple of logs."

At a bend of the river they found a lot of driftwood caught in the roots of a tree, and after some work a number of pieces were cut and laid crosswise on each other.

After the experiences of several expeditions of this kind, to say nothing of the exploring trips, the need of the bolo and ropes impressed itself on their minds. They were never without them.

The river at this point was fully one hundred feet wide, but by the aid of long poles the raft was not long in making the trip. After properly securing it they took up their weapons and at once made a dive for the interior.

The trees were fairly thick, and before going very far Harry checked George with the statement that there was game ahead, as he had heard rustling sounds in the leaves.

Both were now looking forward intently, expecting and hoping that some game worthy of attention would appear. Whenever they stopped, the animal, or what it was, would stop, to resume its motion whenever they moved. This was getting to be decidedly interesting, and at the same time

trying to the hunters. The distance was fully a mile from the river. The noise which came from the slight rustling of the leaves and the occasional breaking of a twig was growing acute.

"Are we hunting or being hunted?" said George, under breath.

Not forgetting the Professor's story of the hunter's careful scrutiny of leaves, they adopted that plan, but it gave them no clue. Whatever it was, it was in front of them, but they were unable to get a glimpse of it.

Once, by agreement, they stopped and were silent for several minutes. The silence was just as profound and continued as their own. It was getting tense, when George hit upon a plan.

"Let us be quiet for a minute or so, and then suddenly bound forward and give a whoop. I think that will frighten him, and enable us to sight him."

"Before doing that get the guns ready for a shot, and don't fire too soon. Don't get excited. Remember the Professor's warning; a shot close at hand, deliberately aimed, is more positive than a dozen shots excitedly fired at a distance."

"When all was ready Harry whispered, "Now!"

With a whoop both started forwardly on a run as fast as the dense underbrush would permit. Before they had gone twenty feet a large leopard-like animal sprang transversely across their path, then, seeing the boys, crouched for a spring. The guns were cocked and ready, and it is a wonder that in the excitement there was not a premature shot.

"Now, steady," said Harry. "Aim, fire!" and

the moment both shots rang out. Harry cried excitedly, "Now for the other guns!"

The other guns were not necessary then. The animal gave a savage growl and bounded to the left, and after they had time to recover, both moved toward the spot.

"We have hit him, sure," was George's exultant shout. "See the blood on the leaves. My! he was as big as a lion!"

"Let's follow him," was Harry's determination. And off they started, the blood tracks plainly showing the way. Not a further view was obtainable of the animal, and in less than a quarter of a mile all blood traces disappeared, to the chagrin of both.

They directed their steps toward the river, but within two hundred feet of the spot where they had last stopped, George stepped back and cried: "There he is now, right ahead of us."

"Let us be careful now; he may be angry." There was no alternative but to fire. The shots were almost at the same instant, and to their great relief the animal, after a single leap, fell down without a groan.

The approach was cautious, because experience had not taught them whether it was safe immediately to make an examination of the body. After some hesitation they went up closer, and when all doubts as to his death had been dispelled a careful examination was made.

They found only a single shot wound between the shoulders.

Here was a dilemma, surely enough. The river

fully a half mile away, if not more, and the brute too large to carry, made them hesitate about attempting to skin it in the absence of the Professor.

"I wish we knew what kind of an animal it is. We had better go home and bring the Professor back with us in the morning."

So taking note of the surroundings, to familiarize themselves with the location, they hurried back to the river, and rafted themselves over. The Cataract home was reached about four o'clock, after one of the most adventurous days spent on the island, although, in some respects, not as exciting as their earlier experiences. They had begun to be veterans. They were not merely boys.

Naturally, the Professor heard a stirring tale, and when it was all told over and over again, he told them he thought that undoubtedly the region beyond the river would turn out to be their hunting preserves, a statement which the boys did not forget to profit by, as we shall see later on.

"I wonder why we haven't seen more animals north of the South River? There have been very few in this section," was George's observation.

"Undoubtedly the mountain region affords them safer retreats, and it is one of the things which indicate to me that we shall find that section very wild, and when we are in shape to do so may be able to have some interesting and exciting times in that part of our domain," was the Professor's response.

"But in South Africa wild animals are found in abundance on the plains."

"True; but they have very thick brush, or cover,

owing to the luxurious growth of vegetation. That affords them means for covering their retreat when attacked."

Following out the usual custom while on expeditions of this kind, they constantly, while on the

Fig. 12. Branch of the Camphor Tree.

way, stopped to examine specimens of plants and trees.

"Here is a branch, with the flower, of a tree, and the smell is very familiar."

"That is from a camphor tree; do you not recognize it?"

"So it is; I know camphor is good for a great many things."

"It would take some time to enumerate the things camphor is used for. Indeed, there are so many that Raspail, a French chemist, years ago found a system of medicine largely on the camphor plant, claiming that it was nature's universal remedy."

"Here is a sample of plant which we found growing in bushes; there were also a few trees with the flowers. It is bitter to the taste."

"This is the Calisaya, one of the varieties of the plant from which the well-known quinine is made. There are at least forty varieties of the plant. This is indeed a valuable find. But I see you have some beans there?"

"Yes; are they good to eat?"

"In South America, particularly in the Argentine Republic, it is eaten as a fruit, and the seeds are fed to cattle. Our yaks would relish them."

"We saw them everywhere on the other side of the river."

"The dry pulp of the seed is very nutritious, and is supposed to have been the food of St. John while in the wilderness, as it is the same kind of locust bean that grows in Palestine, and in various parts of Asia Minor. The Spanish name is Algoraba, or Carob-tree."

"We have brought only one more sample, and it looks very familiar, but I never saw any beans or pods on it like this."

"Don't you recognize Smilax? Of course, it is somewhat different from the kind you know. The root of this kind of Smilax is called Sarsaparilla, and the bean is good to eat."

"Well, I am going to lay in a supply."

The boys could not forget the animal they had shot when morning came, so at the Professor's suggestion, they improvised a raft, which was loaded on the wagon, and a start made for the river.

Tethering the team the raft was launched, and the Professor accompanied them across. A light skid had been made for use in transporting the hide, so they would not be compelled to carry it the entire distance. Before they had reached the spot pointed out by the boys, they stumbled on the animal.

"Why," said the Professor, "this is an Ocelot, very dangerous when attacked, and just the kind of beast to elude you. I commend you for the good judgment in adopting the course you did."

"See here, Harry; I don't understand this. You will remember when we examined him, just before leaving him here, that we found only one bullet hole between the shoulders; this has two bullet wounds, one in the head and the other in the neck."

"Why this is not the place we shot him. This must have been shot by some one else."

"Do you remember what you selected as your marking for the spot?"

Harry looked about, and finally said: "I remember two trees, standing about ten feet apart, east and west of each other."

"That is the place, I am sure," was George's conclusion, after they had made a circuit around the spot; "yes, I am sure those are the trees."

"There it is; I see it."

Surely enough, close to the two trees an animal was found, larger than the one they had just left.

"So it seems you killed two of them," and the Professor was so much amused he could not help laughing as he saw the amazement on the boys' countenances. "You are certainly fine hunters."

"I think—yes; here is the shot in the shoulder—this is the last one we shot. The other one, over there, was the one we followed so long and took our first shot at."

Within two hours the skins were ready, packed on the skid, and delivered at the raft, and after a hard forenoon's work the Cataract was reached shortly after noon.

CHAPTER VI

HUNTING VEGETABLES AND PLANTS

One night, while engaged in the usual evening discussion, many topics were mentioned, things connected with the day's adventures talked over, and plans for the following day considered.

As usual, George was the persistent questioner, but Harry was the one to utilize the meaning, and generally the first to take advantage in a practical way of the information thus obtained.

We have stated heretofore that George was the theorist and Harry the practical one. George delighted to delve down into mysteries; but Harry utilized the knowledge in constructing and building articles. Both, therefore, had useful accomplishments. To learn and to do are the great things in life.

During the day the boys had turned out a nice sample of bread, and George, as usual, began the questioning:

"Professor, you said the other day, that fermentation caused a change in the dough, and that it was due to heat. I am curious to know why heat should cause it to ferment?"

"Heat develops bacteria, a tiny germ, which grows so rapidly in a short time, that millions are produced. These living organisms cause gases to form, and they continue to breed and grow and

multiply so long as they have anything to feed on."

"And we eat all that stuff and call it good?"

"Yes; and why not? Every part of your body contains the little creatures, and they really keep you alive, and preserve your health, as well as prevent diseases."

"Why so?"

"Most germs are of the harmless type, and it is because of the vast numbers of the harmless ones that the few poisonous or disease germs are killed. Water has millions of them in every cubic inch. Professor Dewar, a great English chemist, calls them nature's policemen. If a typhoid fever germ, for example, should be introduced among so many germs, as is the case every day, a fight at once takes place, and where a person is finally attacked with the fever, it is because the germs escaped the policemen who were on duty."

"That sounds like a romance."

"Yes; the life history of those germs is really a wonderful thing, and books have been written about them. They exist in tribes, as it were; some of them can live only where oxygen is present, and some live on nitrogen only; others on carbon. But that is not all. Man has learned to use them, so they will work just as surely as our yaks work for us under our direction."

"How interesting! In what way do we use them?"

"In what is called the septic system of treating sewage. You know that sewage from the kitchen contains all kinds of meat and vegetables, and

the more it has fermented the stronger becomes the odor and the greater are the number of bacteria in the sewage. The sewage in the liquid state is first placed in a reservoir, and at a certain temperature the germs grow very rapidly, and, of course, eat up the vegetable and animal matter until it is nearly all consumed. Then it is run off into another reservoir which has another tribe of germs in it, those that live on carbon, and which are not harmful to man, and when these two tribes meet war is declared, and they fight to the death. The harmless germs are victorious in every battle, and when the sewage is discharged into a stream, or used for irrigating purposes, few, if any, of the harmful germs remain."

"So in using germs the object is to cultivate one kind to kill another kind?"

"Not always; chemists have found out that man and animals absorb oxygen and expel nitrogen, in order to live; and that plants take in and live on nitrogen, and give out oxygen. They further learned that certain germs make nitrogen, just the same as we found that certain germs made carbonic gas in the dough; so that the United States Department of Agriculture, through its chemical division, concluded to set the germs to work, and the department will now send a box containing millions of the tiny creatures to any farmer who applies for them."

"When they get them, how do they set them to work?"

"The germs are thrown into a tub of water, and the seed, like corn, is put into the water and al-

lowed to remain for a certain length of time. When the seed is taken out, more or less of the germs remains on each kernel, and when it is put into the ground the germs keep on working, making nitrogen which the growing plant absorbs. It is wonderful to see the effect in a field where one row has these germ-infected seeds, and the other rows are not so treated."

It was now May, and the weather was slightly cooler, but there was neither snow nor frost. North of the equator it was growing warmer, because the winter had passed. Here the summer had gone, and winter was coming on. From every indication they were not in a cold climate.

"Why do you think we shall not have any snow?" was Harry's inquiry.

"I notice too many trees, as well as shrubs and flowers, which could not live if we had frosts or freezing weather. Many of the trees about here do not shed their leaves, and the kind of animals which we now know exist here are sufficient evidence that we need not fear cold weather."

For more than a week the boys and the Professor put in their time prospecting in the hills and in carting various ores and mineralogical samples to their workshop.

The pelts which were on hand needed curing and besides there were also four yak pelts which had to be tanned, as shoe leather was badly needed. The hide originally dehaired was long ago ready for tanning, as well as the later ones.

"What shall we use for the tanning process?"

"The bark of certain trees must be procured, so

if you can find either oak, hemlock, birch or beech trees, we can probably make a tanning compound which will serve our purpose."

"In what way will the bark of those trees tan the leather?"

"All the barks named contain what is called tannic acid. Other elements also are used, such as gallic acid, alum, sulphate of iron, and copper, salt, and other agents."

"What are the chemicals for?"

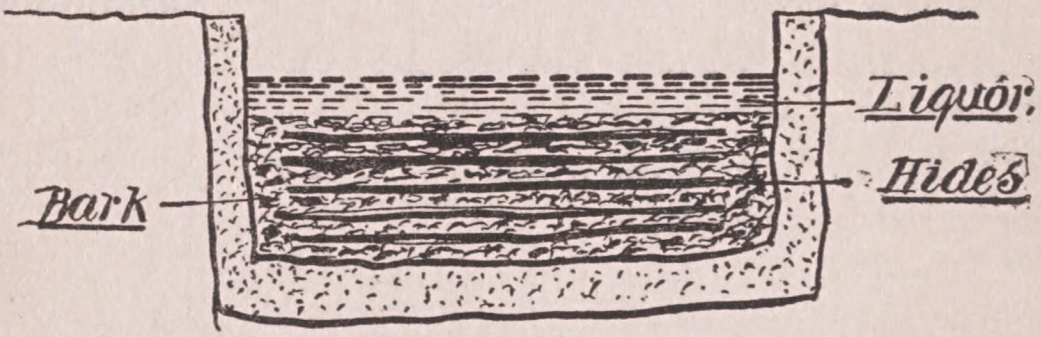


Fig. 13. Tanning Vat.

"The tannic acid or the chemicals act on the skins, or, rather on the gelatin, glutin and albumen in the skins, and thus harden the texture and preserve it. Where tannin is not used and only the chemicals are employed, it is called 'tawing' the leather, instead of 'tanning.'"

"Well, we can get the bark; I know where there are several oak trees, and also a number of beech trees."

"Then gather the bark by all means, and by the way, if you can find gall nuts we could use them to advantage."

"We don't know what they are."

"Then, if you can get some sumac, we can use that."

"Yes, I know; the kind with the long, red leaves."

"That is what I mean."

"Do the gall nuts have tannic acid?"

"Yes; but principally gallic acid, but gallic acid will also tan the skins so as to make leather. The principal use of the gall nut is for making ink."

"What kind of tree does the gall nut grow on?"

"On any kind of tree or bush."

"That is rather odd."

"It is not the fruit of any tree, but is produced by the gall fly, which punctures almost any kind of tree or shrub. In this puncture the insect lays its eggs, and the tree in trying to treat the wound covers up the egg, and the sap, flowing from the tree, forms a sort of nut which finally hardens and produces a most bitter substance deposited by the fly. The nut is about the size of a marble, and must be gathered before the larva is hatched out. It is the most valuable nut in the world."

The necessary bark for the tanning process was ready within the next two days, and a tank prepared in which the hides were laid spread out, with the bark between them and covered with water.

"In our conversations, Professor, you have the habit in describing plants, and especially the leaves to call them by certain names. It would help us if we knew just what you meant by the different names you give them."

"That is a wise suggestion, because it has been said that the basis of knowledge, or of true science,

is correct definitions.* What is meant by that is this: We should both have an understanding of the term used to describe a thing. In our talks I have tried to avoid the use of what is called technical terms, but it is difficult to describe some things without using such terms, and I have for some time thought of making a list of the things we are talking about, and defining them, so you can at any time go there and look up the definition."

Fig. 14. Serrate.

Fig. 15. Bi-serrate.

"If you would make drawings of the different kinds of leaves and give their names we could hang them up and could look at them any time."

"The leaf is the proper part to commence on, because it is the most important thing of every plant, or tree, or shrub."

"What, more important than the fruit or the flower, or the nut that grows on the tree?"

"That is just what I mean. When you smell the rich red flower of the rose, or look at the pure white petals of the lily, or the sweet-smelling blos-

* Each of these books has the Professor's definitions on the last pages.

soms of the orange or the jasmine, you are simply seeing or smelling leaves. The fruit itself, whether in the form of an apple, or a berry or a nut, is simply a form of leaf, a perfected form of the plant, or bush, or tree. Originally all these fruits, flowers and nuts were but leaves in an undeveloped state.

"I never heard of such a thing before."

"It is a subject treated of in botanical knowledge which is called Morphology, and the object is to show that every fruit and flower was developed, in accordance with a well-known law, from the particular shape or form of the leaf. We can go into that branch of the subject later on. What we now want is to know something about the shape of the leaf, so we can have a starting point. There are two particular things about leaves; one has reference to the shape of the leaf, and the other to the way in which the edges are formed. To simplify the explanation, the drawings which I make pertain only to the edges. That will be sufficient for one time.

"Look at Fig. 14. The edges are like the teeth of a saw. This is called the serrate leaf. The rose and the common nettle have such leaves.

"Fig. 15 shows a leaf with a saw tooth edge wherein the teeth themselves have a lot of little saw teeth, as in the nettle-leaved bell-flower, and this is called bi-serrate.

"Fig. 16 has very large, sharp teeth, not pointing in any particular direction, like the oak leaf. This is called the dentate, or tooth.

"Fig. 17 has rounded projections instead of an-

gular teeth, and is called crenate. Ground ivy and horseradish have such leaves.

"When we make drawings of the shapes of the leaves that will take us along another step, and thus enable us to find out just what kind of tree or plant we are talking about."

The following day Harry proposed a trip over to the cave which George had discovered at the

Fig. 16. Dentate.

Fig. 17. Crenate.

time he found the big air pocket that shot water and spray out into the ocean.

"I am interested," he said, "in seeing the air pocket George spoke about, and we might as well take our vacation to-day."

"As the distance is not great we need not bother about taking our luncheon along." And off they started, with the Professor bringing up the rear.

The course was first to Observation Hill, where they had erected a new and a larger pole than the one which had so mysteriously disappeared

two months before. On every such visit it was the duty of the one who made the trip to scan the horizon in every direction.

It must not be inferred that because the boys were engaged in work which was all-absorbing that they had no thoughts of home, and had given up all hopes of a final rescue. If they could only let the people at home know they were alive and happy —that is, in learning the secrets of nature and in the exciting exploring trips, they would be satisfied.

They had no time to think of these things when they were at work, but in the night their thoughts often wandered back again to their homes and friends. Could they be blamed for that home-sick feeling which came over them?

"Now lead the way, George; we want to see some more of your mysteries. Isn't it fortunate that the tide is out? It will give us a good chance to investigate."

The path which George had taken was farther to the right, but as he was in a hurry to get down as quickly as possible he followed a course, which was much steeper, with Harry and the Professor close on his heels.

When the bottom was reached there was no sign of a pocket, or a cave, or anything of that kind. George was very much annoyed. He could not be mistaken in the position, as it was directly to the right of Observation Hill, and not three hundred feet from the spot where Harry had landed on his first trip to the island.

"It seems to me, George, we are too low down.

At high tide this place is all covered with water. It must be higher up in the cliff sides."

Harry scrambled up again part way, and shortly afterwards cried out: "I have found something here; come up at once."

He was distant not more than twenty feet above

Fig. 18. Cave Entrance.

them, but so rugged were the cliffs that the opening was entirely hidden from below.

"This is an example of the corrosive effects of the sea, and of the elements in the water and in the rock. As these rocks are limestone formations, we may be able to see some beautiful decorations within, if the cave is of any extent."

"It is awful dark in there. I wish we hadn't forgotten the candles," he said, as he glanced at the Professor, who seemed to be quite absorbed in examining the rocks.

"Don't you think we had better go in?"

"I should like to do so, but we haven't any candles."

"I thought you came here for the purpose of examining the cave?"

"So we did."

"And came without making any preparations for it?" As he said this he drew out one of the small candles which they had been making and using for their evening work and recreation.

George and Harry were both very much ashamed of their carelessness. The Professor, on the other hand, did not make another remark on the subject. No doubt the silent rebuke was a lesson they would retain much better than if it should be more forcibly presented.

The boys, be it said to their credit, never resented any word or action on the part of the Professor. They had only love and veneration for him; and the Professor, by his constant attitude toward them, showed that even these careless actions or any other examples of thoughtlessness on the part of the boys, were part of the training that would teach lessons of value.

Below the mouth of the cave were little streams of water which looked like springs, and the Professor was of the opinion that the floor or interior of the cave must be lower than the entrance.

"Why do you think so?" was the inquiry.

"The springs below seem to indicate that when the high tide fills the cave, the bottom of the cave leaks enough to let out the water. The height of the mouth from the normal level of the water is much above the usual high tide level of the water, and it is only when there is an abnormally high tide, as on the day that George saw it, when the cave could be filled with water."

"Who will go in first?" said George. "I have no objection to taking the lead; so here goes."

George moved forward cautiously, holding the candle, and Harry followed with another. The opening was fully ten feet high, and at least that much in width, but irregularly formed. They went in straight for twenty feet or more, when George announced that he had reached a wall. The Professor, who was in the rear, called out: "Look to the right, there is a turn here."

Such was the case, but the broken up character of the sides and floor prevented them from readily grasping the formation. After making a jog the cave again turned into the cliff, practically on a line with the opening section or mouth of the cave. It was dark at first, but now, for some peculiar reason, it grew lighter as they advanced, and finally George stopped.

"What makes that peculiar light?"

"It is not a light; it is merely white walls and ceilings."

"What causes it?"

"Carbonate of lime, or chalk, which is caused by lime water coming from above and trickling down through to openings or crevices, and leaving the

deposits there. It is not an uncommon thing in caves, and I foreshadowed it in the cave when I stated that the rocks were of limestone formation. You will remember we made lime from this kind of rock."

A loud splash and a groan-like noise put further conversation at an end. "What was that?" asked George, as he retreated. In doing so he tripped, and, in falling, the light he carried was extinguished as it flew from his hand.

Clearly there was water ahead. "Let us go forward, a little closer," said the Professor. "You might get your guns ready, in case of necessity."

Within thirty feet of them was the edge of water, and the light threw a beam beyond for a hundred feet or more.

"It seems as though we have reached the end of our explorations here." As they looked, the water was agitated, and it was plain that some aquatic animal was within the cave.

To return was the only thing to do, and as they went back the sides of the cavern were examined, and the Professor took a number of samples, as he said: "Don't lose the candle until we get where we can see daylight. Although we are not more than two hundred feet from the mouth of the cave, the remarkable bend or jog near the mouth of the cave makes it as dark as though we were in a thousand feet."

"What sort of animal do you suppose that was?"

"Possibly a sea lion, or a seal."

After the open air was reached the Professor

said: "I do not see how this cave would account for the phenomena that George saw the other day."

"Why not?"

"The cave is too deep. It is not a true air pocket, and——"

"What is this? Here is another one, still larger, and lower down. Here, hold the candle." Harry was down in an instant.

"Probably this is what George saw."

True enough; it was an air pocket which extended in about fifty feet, and had no passageway beyond.

CHAPTER VII

INVESTIGATING THE PROSPECTOR'S HOLE

The knowledge that some marine animal inhabited the cave was now a constant topic, particularly with George, who was determined, sooner or later, to find out something more about it. With this end in view he made secret preparations, particularly in constructing a lamp which would not be liable to overturn or be put out by wind or in falling.

Thus far the only light available was obtained from candles made from the fat of the animals, and it was not the kind of illuminating material they had been used to. When people knew nothing better than tallow candles, that light was satisfactory, but when petroleum was once used tallow candles were entirely unsuitable and too primitive.

The statement by the Professor that the hole into which George fell, some months before, contained asphaltum, hinted at a possible source of petroleum, and through the persistent efforts of George, the Professor agreed to accompany him to the place to make an investigation.

The yaks were yoked, and a good luncheon put up, prepared for a day's jaunt, the trip being planned for the day of the week which had been set apart for exploration purposes. Within an hour the team was tethered at the spot where Harry and

George put up the team when they started out on their former tour of investigation.

"Now, George, we shall have to depend on you to lead the way."

"When I left Harry we were on the little hill beyond that clump of bushes."

"We must have been much farther away," was Harry's opinion.

"Let us go over at any rate, and we can probably get our bearings from there."

The spot pointed out was just as much a mystery after reaching it as before. It was suggested that, as neither knew how to determine the direction of the "hole" from that point, time might be saved by each taking a different direction, with the understanding that if anything was discovered a shot should be fired as a signal.

After carefully noting the two large trees where the team was located, they separated, Harry going to the north, George to the northwest and the Professor directly west. The ridge on which they were ran north and south, and to the west was a decline. It was considerably south of the trail taken on their former trips, so it was really undiscovered territory.

The Professor passed down the long incline, carefully noting every set of bush, such as George declared he had passed through at the time he was deposited in the "hole." When the bottom of the ravine was reached he turned to the right, working his way diagonally up the hill.

George, on the other hand, made for some bush ahead of him, which looked familiar, but in this

he was disappointed, and going to the left, considerably farther down the hill, was rewarded by the rediscovery of the "hole." Without waiting he fired a shot, and to his surprise found the Professor within a hundred feet.

"I have found it. See, that is the place I went through."

Harry was not far away, and he rushed up out of breath. The bushes were swept aside and George went in, followed by the Professor and Harry. He had not gone five feet when he stopped.

Luxurious vegetation around stone and hole.

Fig. 19. *Fig. 20.*

"This isn't the place. There is a big rock here; not a hole."

This was indeed the case.

George's countenance was a study. The Professor and Harry had a good laugh at the discomfiture of George.

"So you think you fell into a hole? It must have been a pretty solid hole." The rock was about ten feet across, and flat on top, and the bush grew all around it, thus entirely screening it from observation.

"Well, we must try again."

"I would like to know why vegetation accumulates around a stone, or around a hole, and gets so much larger than at other places?"

"It is accounted for by the little germs we talked about the other day. Did you ever notice the musty smell that comes up from an overturned stone?"

"Yes, and I have often wondered what it was."

"There is always more or less moisture under the stone, so that the germs are readily bred, and as they form carbonic and nitrogenous gases, which the plant must have, you can readily see why vegetation thrives around the stones."

"But where there is a hole it is drier, and the same thing occurs there?"

"That is a good observation. Two things are required to cultivate the germs, aside from the food. One is moisture and the other is heat. The earth is full of bacteria from which plants get their food; some places the bacteria go down only one or two feet; at other places, where it is warm, as in the tropics, they have been found five or six feet below the surface. When a hole is made, and the sun strikes it, the bottom of the hole gets warm, and thus facilitates the growth of the germs around the hole, so that the plants in the immediate vicinity get an extra supply of nitrogen."

"But where do they get the moisture?"

"That is another one of nature's great surprises, and shows how every contingency seems to be provided for. I suppose you have both cultivated corn—that is, have gone between the rows with a cultivator, and stirred up the earth. You did this,

as you were told, to keep down the weeds. That was one reason, but it is not the principal one. A dry crust forms over the surface of the ground, owing to the heat of the sun. When the cultivator breaks up the crust the heat from the sun draws up the moisture from below, and you are therefore watering your corn, and what is more, you are breeding bacteria so as to supply food for the plants."

"After learning this I am glad we discovered the stone."

A more persistent search was now made, and George's "hole" was really found to exist. It was just as he described it. Everywhere along the hillside were rocks projecting out from the surface, but here was a depression, or hole, fully fifteen feet square, with rocky sides, the wall on the upper side of the hill being fully fifteen feet high, whereas the lower margin of the hole had a wall not over four feet high, so that it will be seen George had no difficulty in getting out after he had recovered from his fall.

The Professor was in the hole in an instant. The growth about the depression was so dense that it made the hole dark, but there was an unmistakable odor of asphaltum. Some of the overhanging branches were trimmed off, and every portion of the walls examined.

"What do you think made this? Was it washed out?"

"Some one dug this hole," was the Professor's response.

"What makes you think it was dug out?"

"There is plenty of evidence to show that. Look at the marks of tools on the walls all about you."

"Do you suppose it was made to get oil?"

"No; but to get metals."

"What kinds, do you think?"

"Gold or silver; most likely silver."

"Do you think we have silver here?"

"Unquestionably; we have some samples of it at the Cataract now."

"When did you get it?"

"At the time we found the lead ore. Silver is usually a partner of lead, and from my examination of the samples we have it is rich in silver. It is likely that the indications of lead and silver all along this ridge attracted the attention of a mining engineer, and this was a test hole in prospecting for the ore."

"But if this hole was dug out, as you say, where did they put the dirt and rock which came out of it?"

"Examine below and you will see."

Below the hole the side was rather steep, but when the surface of the hill was examined there was no longer any doubt of the human agency which made it.

It was with a certain sense of joy that the boys heard this news. The island had been explored by white people; it might again be visited by some wanderers on the sea. This was a comforting assurance. It had the effect of giving new courage, as no other event had, since they reached the rocky shore during that tempestuous night, nearly eight months before.

"Don't you think we can get kerosene here?" was George's inquiry.

"I do not think it is likely. What we see here is a mere trace of surface oozing, found in many places, and it generally indicates petroleum at some depth, but whether in sufficient quantities to pay cannot be determined without boring."

George's hope of a better light faded.

Under the direction of the Professor the balance of the day was spent in gathering samples of minerals, and George, in one of his searches, brought a sample of very peculiar greenish ore, interlaid with patches of brown substance. The Professor was much delighted with this.

"You have found a fine sample of zinc, and if you direct us to the place we must take a quantity of it. I have been specially looking out for samples of this."

The ore was readily found, and a sufficient amount uncovered to complete their load, and late that evening they reached home very tired, but happy.

"Let us do some preliminary work with the furnaces to-day," was the Professor's first observation. "The ore we found yesterday is too good a thing to lie idle. You will remember I told you some time ago that we want some of these metals to be working for us?"

"Just like the germs do?"

"Not just in that way, but nevertheless they must serve us."

"If people get to know so much and have the

different things do all the work there will not be much left for us to do?"

"Do you think so?"

"If one thing after the other is discovered, and it is found that one or two elements can be made to do our work, the time may come when everybody will know so much that man will do nothing but——"

"But direct?"

"Yes."

"Isn't that something? Working with the hands or thinking are not the only things which man can do, in order to go forward and to advance."

"What I mean is this: We are told that idleness is wrong, and that people are happier when they are busy at some useful occupation."

"If that is a good definition of happiness, then we should make everything we use as crude and primitive as the people used to make them a thousand years ago. There would be no object in learning, because learning makes people discontented."

"I heard a story once about some wise man who offered his fortune to the man who could prove he was contented. The first applicant wanted the fortune, because he said he was contented. The wise man answered by saying, that if he was contented he would not want the fortune."

"Quite true; the contented man does not exist, because it is not human nature to be so. That is one of the qualities which distinguishes man from the rest of the animal creation."

"But is it true that the invention of labor-saving

tools has caused a lot of misery to working people?"

"Do you know of any tools that are not labor-saving? The mason's trowel is a labor-saving tool, invented to prevent him from using his hands to put on the mortar; the bolo or the knife is just as much a labor-saving tool as the planing machine; the sickle saves labor and so does the reaper. The difficulty is that some people do not stop to think that the saving of labor applies just as forcibly to a simple tool as to a complicated one."

"What shall we try in our furnace to start with?"

"The ore you found yesterday. The first thing to do is to crush it up as fine as possible. When that is done we can put it in the round furnace."

"You mean in the firebrick furnace?"

"Yes; although we do not need such a high heat. Almost any furnace would do, as the roasting of the ore does not require a high heat."

"What is the best way to roast it?"

"It will be necessary to put it on one of the iron plates, and great care must be taken to keep it a uniform heat, but not too intense."

The process of roasting is a very particular one and requires quite a time to get the best results. When this was done the next step was to take the roasted ore, and mix it with half its weight of powdered coke. They had a good quantity of the coke on hand, which was also crushed.

"You remember, George, we had a crucible made with a hole at the bottom. Get that and also some

fire clay dust, and moisten the dust so we can make a stiff mortar from it. We must make a tubular connection with the hole in the bottom of the crucible."

When this was done the crucible was put into the furnace, after it had been charged with the coke dust and crushed zinc ore.

"Why is it necessary first to crush the ore and roast it, and then afterwards put it in the crucible with the crushed coke?"

"Zinc is not found in a native state. This ore is in the form of an oxide, as it is called. In roasting, certain of the impurities are driven off in gases, and mixing it with charcoal or coke and then applying heat to the confined mass, causes the zinc to melt and finally go off into a gas, as we shall presently see."

After the heat had been applied for some time a white smoke began to appear at the mouth of the clay tube, and a little later a blue vapor appeared.

"Now bring that pan here, so we can catch it."

Soon the dripping commenced, and as it ran out and came into contact with the air, it turned into a solid, greyish color.

"This is what is called spelter, or the pig of zinc, and this is what is sold to refiners, who take out all the dross or impurities so it can be rolled or used for galvanizing iron, or for other purposes."

"I do not see how we can use this metal, now that we have it."

"You said the other night that you wished we had a better light."

"That was the reason I was so anxious to see whether we couldn't get some kerosene at the 'hole.'"

"As we didn't succeed in finding petroleum we shall have to depend on our zinc, I suppose."

"What, light out of zinc?"

"No; but by the zinc route."

That was another new development to the boys.

"Harry made a sage remark some months ago. It was to the effect that in order to start to make anything we had to make something that made something to make something with. In order to make electricity by means of a battery, we had to go through all this process of turning out the zinc, which we have just completed; then, if you have not forgotten it, we had quite a time in converting our copper ore into a copper which we could use. We were compelled to make charcoal, and then coke, with the aid of the charcoal; and now that we have coke, we must again grind it up and make a mortar, so we can form it into little plates or slabs. From the copper we got a liquid, which I asked you to save, and that is vitriol, or sulphate of copper. You see, all these things are necessary before we could possibly attempt to set up a primary battery, and start the first lighting plant."

Not an hour was lost at the Cataract home and factory. All took the keenest delight in forwarding any new enterprise and in looking out for new things to do which would contribute to their pleasure and comfort. The boys now learned what they had never dreamed of before; that life is a most complex problem; that to secure pleasures toil is

necessary, and that the greatest happiness comes from knowing you have succeeded. Pursuit, not possession, is man's greatest joy. To the brute the reverse is true.

"Where is the Professor? I have been bitten by a cat."

"A cat, Harry? Where did you find the cat?"

"Across the river, where I was cutting the oak log."

The Professor was soon at hand. "What is this? A cat, you say?"

"It looked just like a big cat, about two feet long?"

"Did it have a pointed nose?"

"Then it must have been a Zibet, a specie not unlike the American civet. It is a cat, but not what is known as the 'wildcat,' and can be tamed."

"Do you think there is any danger from the bite?"

"Some animals have a species of rabies, like those possessed by mad dogs, and cats have been known to be infected. I do not think we need to have any fear from that source. The wound should, however, be cleansed."

CHAPTER VIII

THE BULL FIGHT

As the boys grew more and more familiar with the island the greater was its store of abundance shown to them. Each journey to the interior brought some surprise in the way of fruit, flower or vegetable. Some were of species well known to them; others unknown, and most of such came to them under names of chemicals only.

"There is one plant, at any rate," said Harry, "that makes this seem like home, and that is the thistle."

"Yes, and it is the one common enemy of man in every part of the world. It is the most successful business plant, in this particular, that it is equipped to resist attacks from other plants and from animals as well."

"But donkeys and some cattle will eat them."

"For the reason that nature has given such animals the proper coating and linings of mouth and stomach that the thorns do not affect them. There is hardly a plant which is as nutritious as the thistle. In England, the thistle leaves, in early days, were used as salads."

Harry was an ardent admirer of flowers, and was constantly bringing in some specimen for examination. "Here is a very pretty flower which is differently colored from any that I have seen before. It looks like the wood sorrel."

"It is the sorrel, but if you should be in Ireland, the people there would call it the shamrock. St. Patrick taught the people that it typifies the trinity with its three leaves. The plant has some very peculiar qualities. It actually goes to sleep at night. It folds up its leaves. It is so sensitive to light that it has at least four different methods

Fig. 21. Fruit and Flower of Vanilla.

by which it can adjust itself with the greatest nicety to the amount of light which it receives."

"I think I have found vanilla; or it is something that smells like it, but I did not know that the vanilla was a climber."

"You have found the wild vanilla, the flowers of which have, as you see, disappeared and the bean is the product."

"I have often wondered why it is that we are able to smell or to recognize different odors."

"Smell, like everything else in nature, is pro-

duced by vibrations. So is sound, and light, and taste. Each odor has its particular rate of vibration. They resemble very much the notes of a musical instrument, and, as in music, odors can be harmonized, or they may be so mixed together as to produce discord. Some perfumes, when used on the handkerchief, and are about to fade away, have a sickly and disagreeable odor. This is due to the admixture of the wrong or discordant tones. Thus, heliotrope, vanilla, orange blossom and almond blend together; citron, lemon, vervain and orange peel belong together, but they produce a stronger impression on the sense of smell, and are of a higher octave; and so with a still higher class, as patchouly, sandal-wood and vitavert."

"But what is it in the flowers or essences which make them smell as they do?"

"Carbon, hydrogen and oxygen. It is one of the most remarkable things in nature that many of the odors in plants are formed by the combination of only carbon and hydrogen, and the wonderful thing about it is, that while turpentine is composed of 88 parts of carbon and 12 parts of hydrogen, the odors of oils of lemon, orange and juniper and rosemary have the exact proportions of those elements."

It was one of the duties of the colony to preserve the seeds of different vegetables and grain, because the Professor intended to put out for their use, as soon as spring came, a garden, which would avoid the necessity of constantly putting them on the alert to hunt the different foods. Sometimes it was necessary to go considerable dis-

tances to get the various foods. As long as they were on the island it was the part of prudence to act like sensible business men, and prepare for the future.

"We haven't a very big variety of vegetables, and I wish we could find some real good sweet potatoes and peas; and tomatoes would come in handy."

"Of course, variety, or the wish for different kinds, is largely a matter of desire. It is not a necessity."

"But does not the desire for different kinds grow out of the need of man to get the different substances which vegetables have?"

"To a certain extent, yes; but it is a singular thing that the world over there seems to be a natural instinct to combine two or three vegetables, and those vegetables, although they may be different in different countries, make chemical combinations, when eaten, which are almost identically similar. Thus, the Irishman mixes cabbages with his potatoes; the Englishman bacon with his beans, and the Italian rich cheese with macaroni."

One morning the boys were surprised to find a startling increase in their herd of yaks. When the Professor arose and went out for his regular morning stroll he noticed the unusual number, and was not slow in informing the boys.

"I suppose," said the Professor, "that they are coming to board with us for the season."

"Well, I am going to inform them, in a not very polite way, that we don't need company."

He was off with a club, Harry following.

"Look at that immense fellow. Wouldn't he make good sole leather? What is that on his side; that funny patch?"

Harry called to the Professor. "Did you see the peculiar mark on the side of the big bull?"

The Professor was on hand at once. "That is certainly a mark of some kind. See if you can get near enough to ascertain just what it is."

George, who had been so anxious to get rid of them, was now just as eager to hold them. The bull was a magnificent specimen. Like all this species he was a dark red, and had immense horns. All yaks, male and female, have horns, and the Texas steer has no horns to compare with the yaks in size and gracefulness of curve.

As George advanced there was no action on the part of the herd to scatter. Their own stock took no notice as he walked among them, and this, in all probability, gave the wild herd confidence. The bull paid no attention, until George was within twenty-five feet, when, with a deep-voiced roar and an ominous lowering and shaking of his shaggy head, made a beeline for him. The Professor called out, and he and Harry both sprang forward to aid him, but the bull's rush was a fierce one, and as we have previously stated, they are very active creatures. George saw his peril, and now realized that he could not possibly reach a place of safety, so he sprang behind one of the cows, and from that point sought to find a way through the herd. The warning voice of the bull, and his mad rush, excited the entire herd, which started a stampede.

In the meantime they had not noticed the presence of their own bull, which was a fine animal, and was now thoroughly domesticated. The Professor was the first to notice the appearance of their bull, who, it seems, had been relegated to the background when their neighbors came to town for their holiday.

Apollo was Harry's name for the bull, and when George got mixed up in the herd, the strange bull made his charge and emitted the challenging bellow, the scene was a truly terrific one. George was carried along with the rush, and his only danger now was to escape being trampled under foot.

Harry stopped suddenly: "Look at Apollo!" He was making a charge down into the herd, and headed straight for the big bull.

"I thought it strange that we didn't hear our herd give them a welcome during the night."

"Welcome! what do you mean?"

"It is singular that Apollo didn't dispute the governorship of the herd when the new arrivals came, as that is one of the customs. One of them must be master."

"Just look at him! Good old Apollo!"

At that moment Apollo was within ten feet of the wild bull. He did not cease his onslaught. The wild animal saw his enemy attacking him from the right quarter, but his rush had been so impetuous that when Apollo struck him he rolled over, one of his large horns striking the earth and serving as a fulcrumed lever to turn him around in

his path. He was up in an instant, and now began the battle for mastery.

"Get the guns, Harry; get the guns," and this was a sufficient reminder that neither of them had a weapon.

Harry bounded over to the house, and within a minute was back with them. In the meantime, where was George? He did not need to be told that he must run for his life, and was wise enough to seek the security among the cows, but he could not foresee a stampede. It was fortunate that the big bull was behind the herd when the stampede began, and it was lucky that there was plenty of room for the animals, or he surely would have been trampled to death. Naturally, the noise of the rushing animals drowned the roar of the fighting bulls, but the stampeded yaks gradually checked themselves, and George was the most surprised individual imaginable when he found the bull was not behind them.

And now another curious thing happened. They had run fully a quarter of a mile, and when the running stopped, the yaks leisurely turned around and slowly walked back. The movement seemed to be a concerted one. George accompanied them. He didn't know what else to do.

When Apollo and the bull locked horns, after the latter had again gained his feet, his tremendous bulk pushed Apollo back, at the first onset; but they noticed a peculiar tactic on the part of Apollo. The latter at each forward plunge twisted his head, first to the right, and then to the left, as though he was boring his way in. This

was an astonishing thing to the stranger. This was done by Apollo over and over again, and now, every time they met, and the twisting motion was repeated, his enemy would be thrown back on his haunches.

For a period of twenty minutes the combat continued. Back and forth they ranged. Harry, although intensely excited, wanted to give the bull a shot, but the Professor restrained him. He felt that the youth of Apollo was enough to overbalance the strength of his enemy.

"No, Harry, when they get through with this battle the big fellow will not cause us any more trouble, and we need him."

The herd of cows came up and remained standing at a respectable distance. They seemed instinctively to know that the question of kingship was being decided. It was entirely immaterial to them who won. George did not wait with the herd. He saw the combat, and beyond the Professor and Harry.

"Well, you did kick up a fuss, didn't you?" said Harry.

"Apollo's got him; he'll lick him sure. See that lunge? My, what a shaking he gave him that time!" George was a dancing Dervish by this time. Then noticing the guns for the first time, seized one of them. "I'll finish him."

"No, no, George," was Harry's reply, as he grasped the gun. "The Professor is right; Apollo will finish him."

There was now no question of the fighting ability of Apollo, and of his youth and vigor, and he

knew it. His antagonist did not rush any more. Apollo did that; the bull's main business now was to keep out of Apollo's way.

He had been whipped, and he knew it. He turned and fled. Did he go toward the cows? Not at all; but in the opposite direction. Instinct told him that if he had gone toward the cows it would have meant another fight. To leave them was the bovine manner of saying, "Well, then, take them."

The big bull did not go far. His head hung low, and the heaving flanks showed he was tired. But Apollo's head was high in the air. Dejection on one side and absolute mastery on the other were as plainly exhibited in the manners of the animals as though it had been written out and proclaimed.

"What will he do if I go up to him now?"

"The fight is all out of him."

This was true. He exhibited no alarm when they approached, and when they walked around to get a view of his other side, the mark plainly showed the following brand: "M—V."

"That is undoubtedly the brand of some person who captured the animal when young."

"How old do you suppose he is?"

"It is difficult to fix his age with any certainty, but I do not think he is over ten."

"What do you suppose the brand means?"

"It is some arbitrary term, the initials of a person, or it may be intended to designate something. Branding is a very common way of marking cattle, so as to indicate ownership; nearly all savage tribes have a habit of branding, or tattooing; and

sailors also. Various civilized countries in the past have branded criminals as a means of identifying them."

They now had an opportunity of taking an inventory of their stock. The original herd comprised Apollo, six cows and four calves, or half-grown cattle. The new acquisition brought the count up to twenty-six cows and twenty young animals. The vanquished bull was very meek from

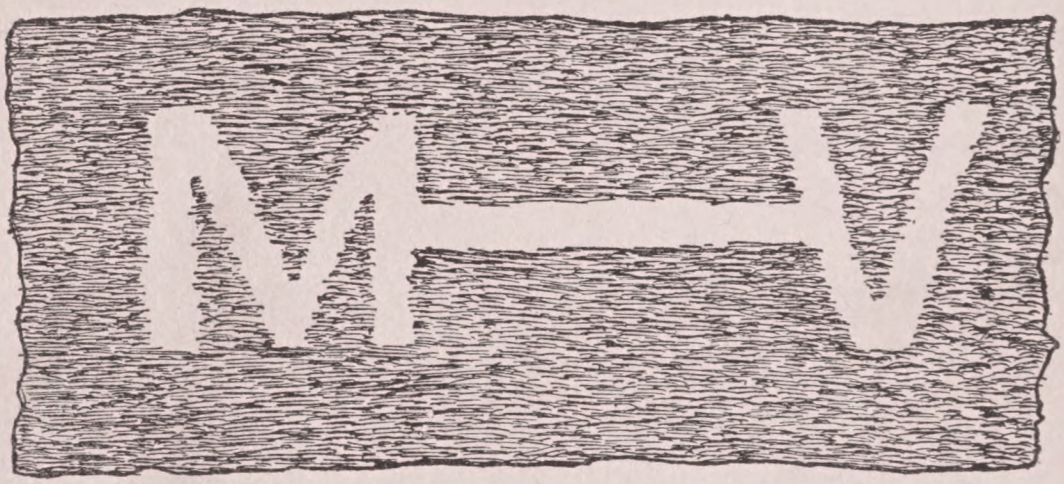


Fig. 22. The Mysterious Brand on the Yak.

that time forward, and the surprising thing was that Apollo was thereafter the same quiet, unobtrusive animal he had been before.

But there was work to do in the factory. Harry was now engaged in building an iron lathe for their further work. A drilling machine was his next tool, and as the weeks passed the boys devoted much of their time to making such articles of machinery as could be used advantageously to turn out the simple products which future needs might demand.

The leather vats were examined and the skins found in excellent condition. These were then taken out, and grease and oil worked into them until they were pliable. The thick parts of the hides had been previously cut out, so that they could be used for the soles of contemplated boots and shoes, which they soon hoped to turn out.

Every morning the yaks would leave the enclosure and start out on trips to the feeding grounds, and sometimes Harry or George would follow them and hunt for game. On one occasion, while Harry was on the opposite hill, George saw the flash of Harry's gun, and almost immediately thereafter heard the report. This was the first time the difference between the flash and the noise attracted his attention.

"Will you tell me why I saw Harry's fire before the sound reached me?"

"Did you say 'sound' or 'noise'?"

George looked at the Professor quizzically. "Is there any difference between sound and noise?"

"Technically, there is a difference, although in common practice one word is used for the other without discriminating. Sound means a succession of vibrations produced in their regular order, like music, whereas noise is a disorganized vibration. For instance, falling water, like our cataract here, is sound, but the report of George's gun was a noise."

"I can see the difference. Would a wagon going rapidly over a pavement be a noise or a sound?"

"It would be a noise if the pavement should be

irregular, but if the pavement is regular and the vibrations or beats are uniform, it is then called a sound. But you wanted to know why you saw the shot before you heard it. Simply because sound does not travel as fast as light. Sound moves 1,040 feet in a second, and light over 186,000 miles a second, which is about 850,000 times faster than sound."

"Do soft and light sounds travel at the same speed?"

"Theoretically, yes; but numerous experiments have been made, and many of them go to show

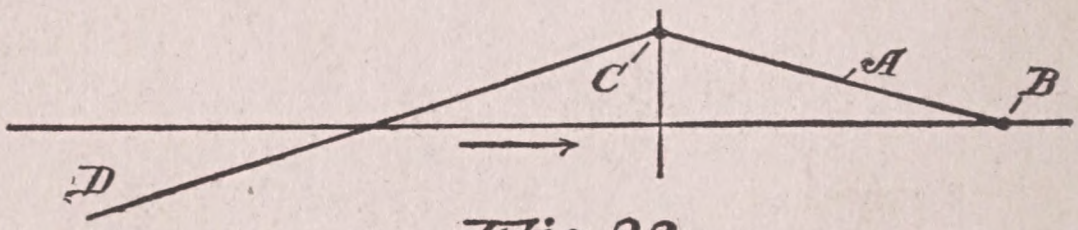


Fig. 23.

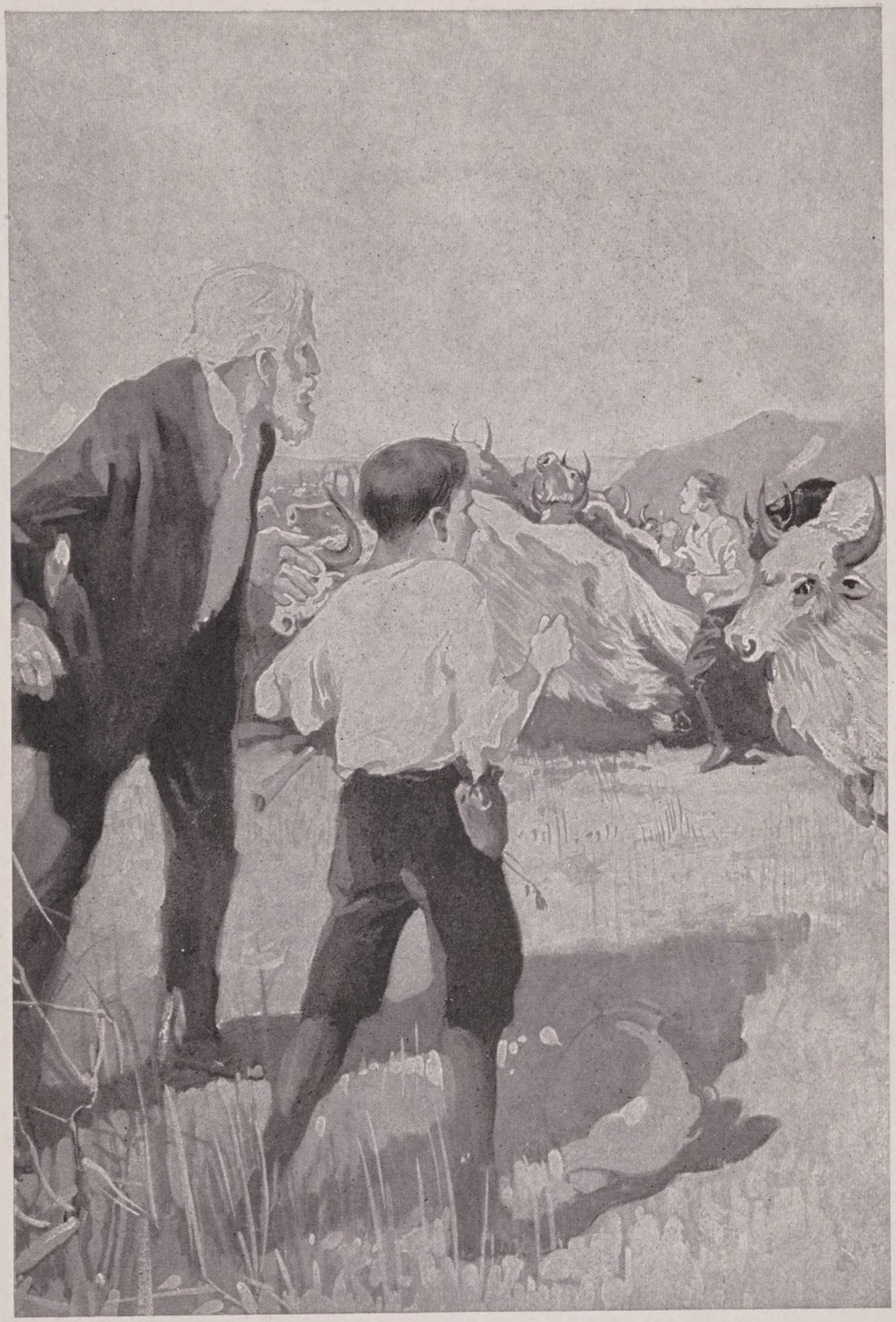
MEASURING SOUND PITCH

that a loud noise really travels faster than a soft noise."

"What is the cause of that?"

"It is attributed to the belief that a loud noise causes greater wave motions, although the sound waves may be the same lengths in both cases. Or, it might be said that loud noises have greater strength."

"When we were going to New York in the cars, a train was coming toward us, and the engineer on that train blew his whistle when he was off quite a distance, and kept it up until long after he had passed us. I noticed that when the whistle



"George saw his peril and now realized that he could not possibly reach a place of safety"

[See p. 95]

started the sound had a very low pitch, which kept increasing to a higher and higher pitch until the train passed; what was the cause of that?"

"As the sound waves are uniform movements, and are at regular intervals, the vibratory action of the whistle, in case the trains were at rest, would all be the same distance apart; but as the two trains were coming together two things happened. At each moment your ear came nearer the whistle, and the distance through which the sound had to travel decreased. This made increasingly shorter waves, and not long, regular waves, as when at rest. Short waves make a high pitch, and long waves low pitch. After you passed the train the waves began to get longer, but they increased in length more rapidly than when you were approaching each other, so that if the whistle kept on blowing the waves would finally get to be so long and so far below their original pitch that the sound would cease.

"A little sketch will show this. (Figure 23.) The line A is the pitch of the whistle; B its pitch when you first heard it; C shows the point where you passed the whistle, and D shows how low the pitch was when it died away."

CHAPTER IX

EXCITING EXPERIENCES WITH THE BOATS

During the nine months' life on the island all had the best of health. The Professor grew strong, and he declared that his constitution was more robust than it had been for years. They lived in the open much of the time; their fare was plain and mostly devoid of sweets; the store of honey which had been several times replenished, was the stock article in the absence of sugar.

It was, therefore, a matter of surprise that Harry should complain of having a tired and uncomfortable feeling, and would frequently lie down during the day while in the workshop. The Professor was always at his side during these periods, and while he had no instruments to enable him to determine whether there was a high fever present, the flushed face of his patient showed unmistakable symptoms.

"Do you think he has a very severe fever?" was George's inquiry, as the Professor left Harry.

"It seems so, and in order to determine whether there is any change we must at once set to work making a thermometer."

"We have neither mercury nor glass, and even if we had, how can we make a tube for it?"

"That being the case, we must make a substitute for both."

"But we must have something which will expand."

"We can use iron for that. Get a piece of small steel bar, say two inches long, and bend it in the form of a C. In the meantime I will make a base to hold the thermometer."

"For your guidance I make a drawing (Figure 24), in which A is the base, about five inches long, three inches at its widest end, and an inch wide at the narrow end. This should be made of a thin

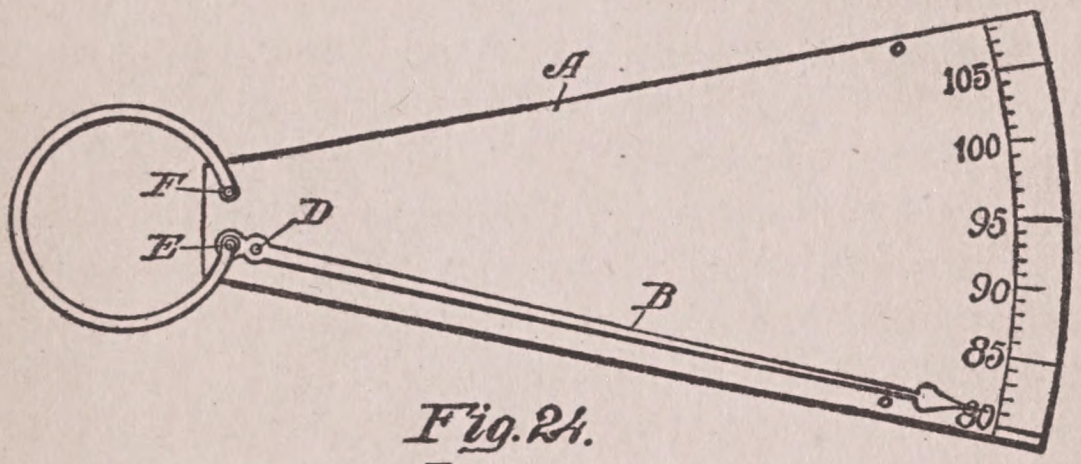


Fig. 24.
THERMOMETER

piece of hard wood. Bore a small hole in each end of the C-shaped piece. The next thing is to make a pointer (B) nearly as long as the base, pointed at one end, and provided with two holes at the other. The pointer is attached to the base by a pin (D). One end of the C-shaped piece of metal is then hinged to the other hole (E), and the other end of the C-shaped piece is hinged, as at F, to the base. You will now see that if the ends of the C-shaped piece spread apart the least bit the long end of the pointer will swing over to the other side of the base."

"Do you intend to make the thermometer show the exact degrees of heat we really have?"

"Yes; as nearly as possible."

"Why can't we make it exact?"

"For the reason that to make what is called the Fahrenheit scale we should have freezing weather. The scale adopted by Fahrenheit was an arbitrary one. He determined it in this way: The temperature of his body was taken as one point in the scale. For zero he took the lowest temperature observed by him in the year 1709. As the temperature of his body was 86 he made a scale with 86 degrees on it, and then when he observed ice melting in water he put his thermometer in and found it registered at 32 degrees. It was not a very scientific way of doing it, but it answered the purpose, as, of course, temperature is merely a relative thing."

"But isn't there another scale to measure heat by?"

"The Centigrade method is on a more scientific basis. It is determined by taking the freezing and the boiling points of water, and dividing the scale into 100 degrees between those points."

It required the work of several hours to make the device as here shown, so that the tension of the C-shaped piece would hold the point to one side. The temperature of the atmosphere was about 65, as nearly as the Professor could judge, but when the C-shaped piece was held in the palm of the hand, the pointer moved to the lower edge of the base piece, and a mark of 80 was put there as the starting point. As they had no immediate

use for a scale beyond 110 degrees, the end of the base was marked off, as you see in regular divisions.

The C-shaped piece was put under the tongue or in the armpit, so that the temperature of Harry could be determined, and it registered 102 degrees. It might be that Harry's temperature was really much higher, as the thermometer, for the reasons stated, was not accurate.

"I wish you would test the thermometer, George, so we can pretty well determine, within a range of two or three degrees, how nearly right we are."

George's temperature was found to register 98, whereas the Professor's was only 90. He explained that the temperature of youth is normally greater than old age, but it was remarkably close to the average normal temperature of two healthy persons.

"The advantage of the instrument now is to enable us to ascertain whether Harry's temperature will increase or decrease."

"Is there no other way in which we can find out about a fever?"

"When the fever comes on the pulse is usually quickened, as well as the breathing; the bowels are apt to be constipated; and thirst, loss of appetite, headache, and vague pains are felt. When the temperature goes beyond 105 it is very dangerous, and it is for this reason that physicians want to know the temperature."

"I am anxious to know why that C-shaped piece should try to straighten itself out when heat is applied to it?"

"When you bent the metal piece of which it is made you crowded the metal on the inside of the piece together, and also stretched the metal on the outside of the bend. As the application of heat expands the metal, the contracted particles of the metal on the inside of the piece pushed against each other with greater force than those on the outside, and the bar tried to straighten itself out again."

"I have noticed that if a hose is coiled up and water is forced through under pressure it will straighten out the hose. Is that also the case with the hose?"

"To a certain extent only. Another principle comes into play in that case. Water under pressure acts as a solid, and has a tendency to move along the shortest route or in the most direct way. If, therefore, there is a crook in the pipe the water tries to straighten it out. Steam gauges are made of flattened spirally coiled tubes. One end of the tube is open and the other has an inlet for the steam. The dial finger has a connection with the moving end, and by that means pressure is indicated."

The next morning Harry's temperature was fully one degree higher than the previous day, and the Professor advised that it would be necessary to administer some fever medicine.

"Last week you found several samples of the gentian flower. It is a first-class fever medicine and tonic. Do you think you could distinguish it by its large blue-colored, fringed flowers?"

"I know what you mean; it has one central stalk,

with big leaves at the bottom which gradually grow smaller, and in which the stem seems to go up through the flowers."

"That describes it exactly. Get some of the roots, and peel them, then scrape a quantity, so we can give some to Harry."

This is a simple remedy, in the absence of regular fever medicines which were not available to them.

To their great relief the fever abated before morning, and by persistently taking the gentian tonic Harry was soon well again.

This little experience was sufficient notice that in health at least some preparation should be made for illness, which is sure to come to all at most unexpected times. It had also a stimulating effect in more pointedly directing the attention of the boys to the wonders of the vegetable world.

It was now the latter part of June, and the weather was not at all cold. Plenty of rain had fallen, and the Cataract stream had risen so high that their water wheel had been out of commission for several weeks, and Harry's illness or indisposition had somewhat retarded the work in the factory.

"Wouldn't it be a good idea to look up that animal over in the cave?" was George's first suggestion, one morning, shortly after Harry's recovery. "We might put in a little time there, and then go down around the bay on a little tour."

This was agreeable to all, and then George remembered the want of the candles. Zinc had been turned out, as previously told, but no steps had

been taken toward making a battery which would be the starting point for an electric lighting system, as Harry and George both hoped for.

"It seems to me," said Harry, "that we ought to explore the coast line to the southeast of us, as we have never been in that direction, and then work our way around to the cliff cave."

Without further words the yaks were yoked up, and taking a hearty luncheon they were off for the east coast, where the bay indented the land. The coast was reached within two hours, a great deal of the time en route being spent in gathering samples of plants, flowers, and fruit, of which some species of trees were filled.

To the right of the place where they struck the sea was a cape which ran out into the sea for fully a quarter of a mile, and to the south of this was the mouth of the South River. As they had definitely planned to go north along the coast line to the cliff rocks, the explorations to the south must be reserved for some future day.

The sea front showed delightful stretches of beach, but at intervals small trees and bushes grew close to the ocean on the elevated spurs which broke up the otherwise smooth beach line.

The clam, as a source of food supply, had practically been neglected, because it was quite a distance from the Cataract home to the beach, and principally for the reason that other foods were so plentiful. Harry wanted some clams, and with one of their bags the beach was scoured for fully a mile, until he gathered a staggering load.

As he reached one of the little knolls which

broke off abruptly close to the sea, Harry dropped the bag and ran to the brush. The Professor looked on in wonder. When Harry disappeared in the bush George and the Professor both hurried forward. Harry reappeared in an instant.

"What do you think I have found?"

"Another cave?" queried George, without stopping.

"No; our boat."

There, perched less than five feet above the level of the ocean, was the boat which they had left at the foot of the falls in the South River, fully three months before. One of the puzzling mysteries was solved.

It was some labor to dislodge the boat from its position between the cleft branches of shrubbery which also held other debris, and furthermore the boat was full of all sorts of rubbish. This was laboriously removed.

"You will remember I stated at the time of the disappearance the most likely explanation would be that high water coming on suddenly would wrench the boat from its fastenings, and——"

The Professor got no further; he suddenly stopped and glanced to the forward end of the boat. "Who tied on that rope? It really does look as though some one has used the boat. That is not one of the oars we made."

"But where are the lockers we had on the boat, in which we put our provisions?"

"They have been removed by some one. This is a rope entirely unlike any we have had, and it is a native, or rather, hand-made article."

"Well, we have struck a greater mystery now than when we lost the boat."

This discovery brought up several other questions which, as it now appeared, might be linked together. The removal of the flag and flagstaff; the "hole" in the hill; the fire in the forest; the branded bull, all indicated that people had, at various times, visited the island. But the finding of their boat, with the positive evidence furnished by the oar and the rope, was conclusive, and what made it the more interesting was the fact that the island must have had such a visit within two, or at the most, not over three months ago.

Each was too busy to give much time for discussing the probabilities. They had entirely forgotten the cave. It was, by common consent, agreed that the boat must be taken home, and it was finally decided that the boys should pilot it around the point, past the cliffs, and in that way reach the mouth of the Cataract River, where it would always be convenient for cruising purposes.

It was fortunate that the sea was calm when the boys pushed the boat from the shore. It showed signs of leaking here and there, but the Professor assured them that the water would close up the joints before long. The Professor, himself, drove the team to the Cataract, and after unyoking them, followed the course of the river down to its mouth, to await the coming of the boys. He waited there until sundown, but the boys did not appear.

Let us now follow the boys. Lashed in the boat

were two oars, as carefully secured as though tied only the day before. At the bow was the rope which the Professor discovered, after he had noticed the one tied around the oars. It will be remembered that the boat had been fitted with a mast and a sail. Those had been removed, as well as the crosspiece and the brace which held them in place. It was, therefore, necessary to row the boat around the point. The distance, as calculated by the Professor, was two miles or more to the cliffs, and fully a mile from the extreme point of the cliff to the mouth of the river.

Shortly after they started on the journey a light wind sprang up, which, however, did not seriously interfere with their progress, but it was sufficient to induce them to take a course outside of the point, instead of attempting to thread their way inshore between the rocks.

When abreast of the extreme point George's attention was directed toward an object on the cliff.

"What is that up on the rocks?"

Harry stopped rowing, and looked in the direction of George's extended arm. "It looks like a boat. Let us go in."

The boat was pointed to the shore, and drawn up, and in their eagerness, each tried to gain the elevation first. A miscalculation was made, in the attempt to reach the object, which was not visible from their location, and they were compelled to thread their way down again and go around the broken side of the cliff walls.

As they were about to ascend Harry called out: "Look at the boat, George! Run quick, it is

adrift!" The wind had quickened, and they realized their carelessness in securing it at the landing place, and before George, who was lower down, could reach the water's edge, it was washed around the point of the rock, out of his reach.

Here was a dilemma. The boat lost, and no means to reach the mainland without swimming. The place where they landed was less than five hundred feet from the spot where they were cast ashore months before. Innumerable large rocks, detached from each other, formed the immense tier of sentinels for this part of the coast, and Harry's trip across, when he had the benefit of the life-preserver, was an entirely different thing from their present condition.

To add to the perplexity of the situation, George was not a good swimmer, and he doubted his ability to make the trip across the channels between the rocks which separated them from the mainland.

"Why not try to find the object we saw while we were out at sea?"

"Good idea. But I would like to know how we are going to get up?"

"Wasn't that a silly trick, to be so careless about our boat. What will the Professor say?"

At last, after repeated trials, they found a way which led them up the craggy sides, to the object they had seen.

"It is our life-boat," was Harry's excited cry. "That is, what is left of it."

We have previously detailed how, when they struck the rock, on that eventful day, months be-

fore, the boat had apparently been broken in two, and they saw only the stern of the boat held within a saddle of the rock; and how, at the next great wave, even that portion had disappeared. Here was the battered and broken-up part that remained.

"Do you think this part would float?"

"I suppose it would, but how can we get it down?"

They sat down, not discouraged, but annoyed at their own stupidity and carelessness. Night was approaching, and sitting down would not remedy matters. It was low tide, and the waters had receded, so that the wrecked boat was now fully twenty-five feet from the water. It was held within a wedge in the rocks, tilted up, and it was too heavy for them to lift. If they could possibly dislodge it, so as to push it over the edge, it would probably be crushed to pieces in tumbling down.

Even such a calamity would be better than remaining there, and it was decided to be the only course now available. Every vestige of the locker, or seats, or other appendages of the boat were swept away. The bare shell of the stern portion remained.

It was now growing dark, and when the wreck was finally dislodged and fell down with a crash the boys made their way down the sides very cautiously. It was now but the work of moments to get afloat. The boat originally had water-tight compartments, but these were now utterly useless as a means of sustaining the vessel; nevertheless,

it was a means by which they might reach land, as they felt sure it would not sink. Here was another difficulty. They had neither oar nor other means of propelling it to shore. After considerable effort a portion of the side of the boat was broken off, and tired and worn with the effort and excitement they steered the craft shoreward. To do so was not an easy task, as the wind had increased, and the waves beat stronger, but this had no terror for them after all their previous experiences.

When the shore was reached Harry had one positive observation to make: "I am going to see that this boat is so fixed that it won't get away."

George looked around, and in spite of their trials, could not help laughing at Harry. "I should like to know how you are going to do it. I don't see any ropes around here, and trying to pull it up this steep beach wall will not be an easy job."

"Then we have got to take it where we can pull it up. I am tired of losing things in this way. We'll have a nice story to tell the Professor."

The Professor was by this time thoroughly alarmed, as well he might be, for it was past eight o'clock that evening when, going down from Observation Hill, he heard voices in the distance, and recognized the boys. He called to them, and you may be sure that their answering voices were joyful sounds.

When the boys appeared both began excitedly to detail their experiences, getting details of the

story involved without any sequence just as we might expect an exciting, mixed-up recital of this kind to be under the circumstances.

"You lost your boat and found the other one. You are having enough experiences to fill a book."

CHAPTER X

THE BIRTHDAY PARTY; AND THE SURPRISE

You may be sure that the interesting topic of conversation that night had relation to the events of the day. All previous experiences were insignificant now in comparison. Every phase of the question was discussed, and a solution sought.

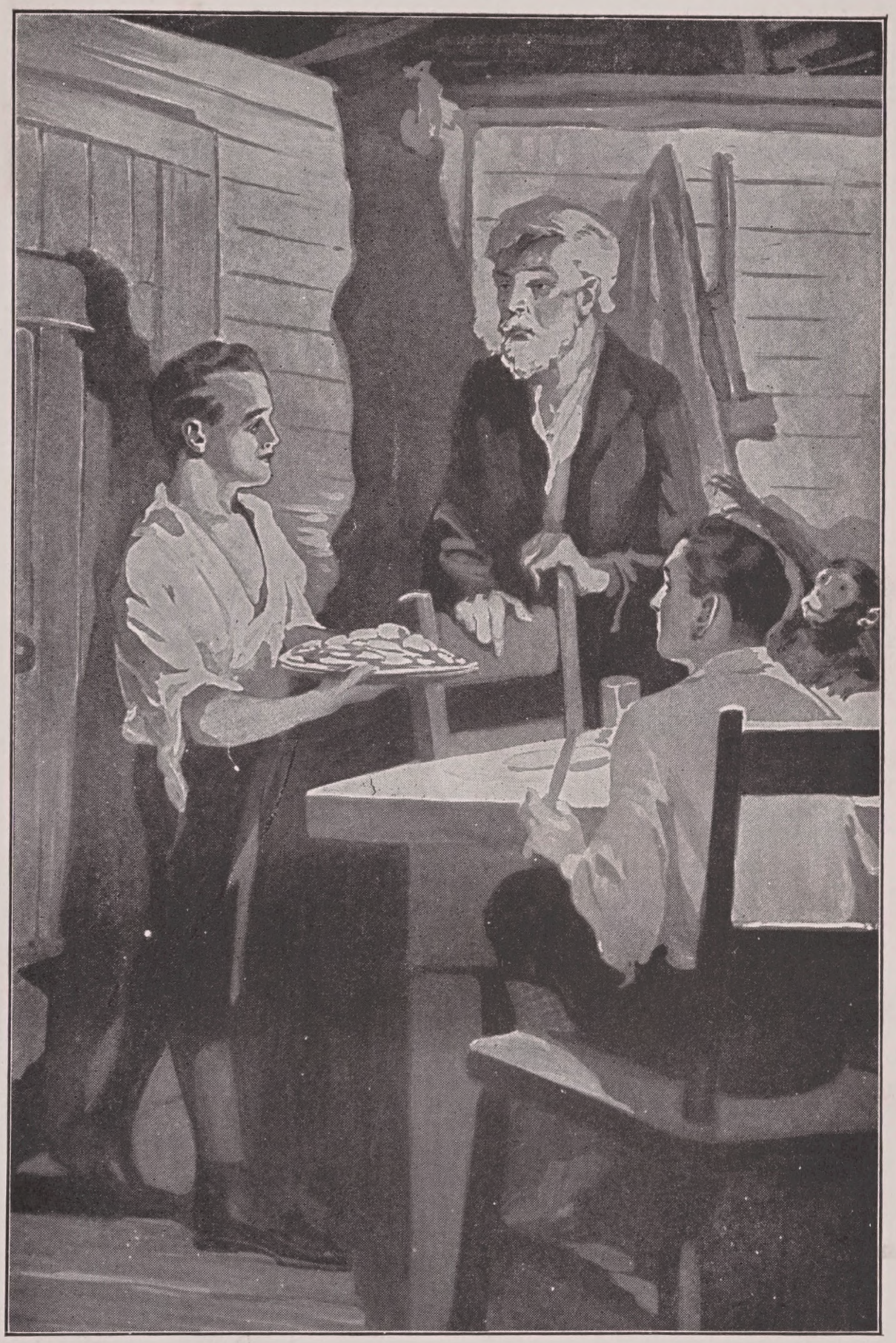
The Professor did not attempt to conceal his doubts. "I have a theory that we are or may be near some other island, possibly inhabited by white or civilized people. It is likely that people from those islands may visit this place at intervals, and that the boat which we left at the falls was really washed down to the sea and found by some of them."

"If that is the case, why should it be washed up on shore, as it was? They, no doubt, used the boat, as the oars and rope showed. But I can't possibly make out the meaning of its being in the driftwood."

"That boat we made is a hoodoo," was Harry's conclusion. "Twice lost is enough for me."

"Well, I would take a sail in it the next day if we could only find it."

"I am interested in it," observed the Professor, "not so much for the purposes of its use, as to enable us to find out something more about it, and how it came to be there. If it had occurred to me that we should lose it so soon you may be



"'What is this, a party?' said the professor. 'Yes, a birthday party,' said Harry"

[See p. 130]

sure I should have made a more careful examination of it when we had it. But it is too late now."

Harry's solution was the one most acceptable. "Let us make another boat, and with that we can carry on our investigations more satisfactorily."

"Harry is right. A good vessel will be a measure of safety, in the event we should be attacked by savages, and it will at least enable us to visit the shore line of our continent."

The sanitary arrangements of their kitchen had been for some time very unsatisfactory, and somewhat cramped, and the Professor thought it would be wise, for their comfort and health, to cleanse it thoroughly.

"I am inclined to think that Harry's sickness was caused by the condition of the kitchen. We are apt to overlook these things in the multiplicity of our work."

"What is the best way to clean it, by washing?"

"That is necessary, of course, but it is impossible, even by a liberal use of hot water and soap, to remove many of the poisonous germs. Some good disinfectant should be used."

"Have we anything which could be used for the purpose?"

"There is nothing better than charcoal. Common wood charcoal has the capacity of purifying and rendering odorless almost all impurities."

"In what way does charcoal do this?"

"When charcoal is crushed up finely its remarkable porosity enables it to absorb an enormous quantity of gases, and when so absorbed it con-

denses them, in which condition they are harmless, or they are retained in the charcoal."

"But how about the impure liquids?"

"Its affinity for sour and stinking liquids is so great that two tablespoonfuls of charcoal will purify a pint of the foulest sewage; it will also, in that quantity, absorb 100 cubic inches of gaseous ammonia."

"Have we anything else that can be used?"

"The sulphur that is in the samples of copper ore, if burned, will make a sulphurous acid gas, and while it must be carefully used, on account of its noxious and offensive odor, is a most powerful germicide. Or if we take some of the green acid of the copper, and make a liquid of it, and then pour this over common salt we are making what is known as muriatic acid. The vapor of this acid will destroy all germs. The objection to this, however, is, that it has an odor which is worse than the impure or unhealthful gases. In the last samples of ore we brought home, you may have noticed a very black lot of stuff. That was manganese. If we take the muriatic acid, which I have just referred to, and pour it over the manganese, we can make the most powerful agent of all, namely, chlorine."

"Chlorine is used for bleaching, isn't it?"

"That is its great use in the arts; but as a purifier it has no equal. It will decompose every gaseous compound and evil-smelling gas which escapes from decayed animal or vegetable matter."

Harry did not let the Professor forget the matter of the primary electric battery which he had

been making preparations for, and after they had gone over the sanitary features of their kitchen, he was anxious to make a start. George was equally insistent, because the question of a better light was ever uppermost in his mind.

"Then here goes for the primary battery. We haven't any glass, nor have we found any rubber lying around, so we can make cells out of them, so what shall we use?" was the Professor's first inquiry.

"Why not use some of these iron pots we made?"

"I am afraid iron would not last very long, with sulphuric acid in them. We should use some non-conductor of electricity."

"What do you mean by non-conductor?"

"That quality in a material which will not allow electricity to pass."

"Then why can't we use clay? Will that conduct electricity?"

"That is just the thing. Isn't it wonderful what a friend common clay has been to us since we have been on this island!"

"I think we ought to erect a monument to Monsieur Clay?"

"It would be a fitting thing to do, because at the end we are all bound to go back to him."

"I believe you said, Professor, that we should have to grind up the coke and then mix it up and make plates out of it?"

"Yes; we can use either carbon or copper for the negative plates."

"What are the other plates?"

"The positive. That is what I wanted the zinc for, which we made several weeks ago."

"Why should we have positive and negative plates in a battery?"

"Everything must have an opposite. If there is an up there must be a down; there would be no darkness without light; no heat without cold; no strength without weakness, and no joy without sorrow. Like all these things, the electric current flows from one to the other."

"But in electricity the current flows only one way, does it not?"

"In the primary battery that is the case; but when electricity is generated and sent over the wires, the natural current flows in both directions —that is, it goes in one direction as much as in the other."

"I do not understand what you mean by that."

"The current alternates. What is meant by that is this: For an instant the current flows from the positive to the negative, and the next instant it flows from the negative to the positive, and so on, making the alternate current."

"Then the primary battery we are going to make will be another kind of current?"

"We shall make what is called the direct current which goes in one direction only—that is, within the battery it moves from the positive plate, the zinc, to the copper plate, or negative, and outside of the battery it moves from the negative to the positive plate."

"Why does it do so?"

"In order that you may understand, I shall make

a drawing so Harry will not have so much trouble in arranging the parts. So if you will examine the sketch (Figure 25), you will see that the clay cell, which we are to make, has in it the two electrodes, A and B. That is what they are called when they are spoken of together; but the positive

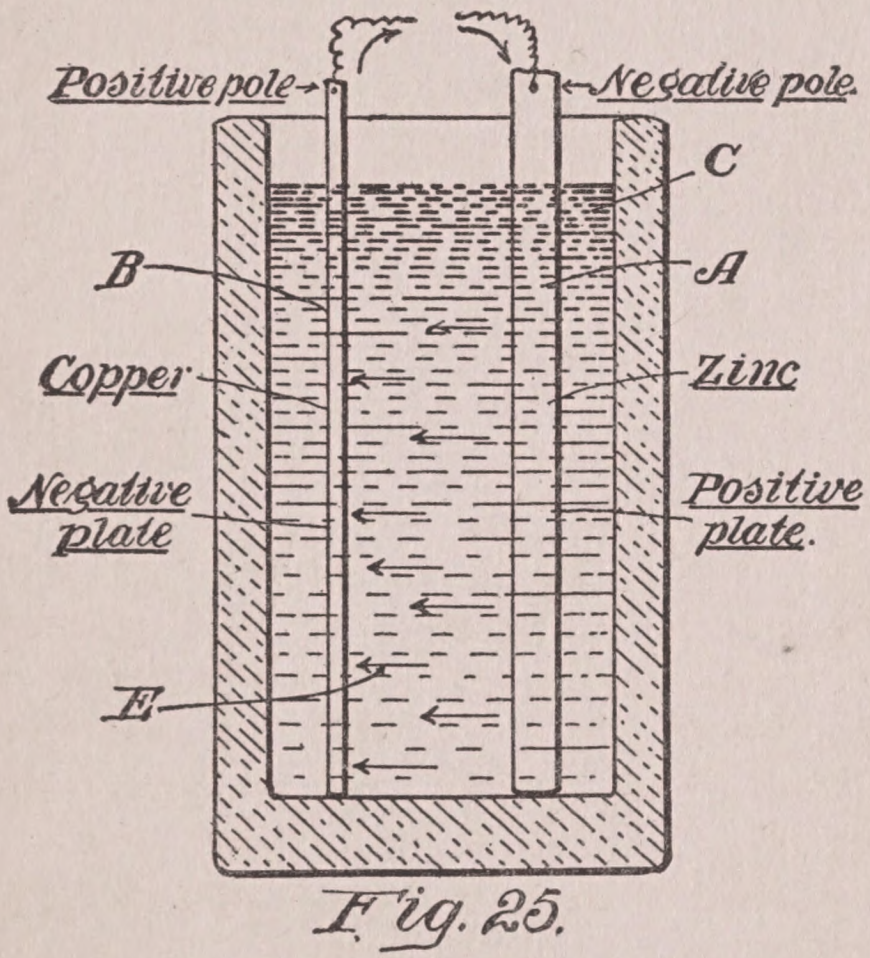


Fig. 25.

PRIMARY BATTERY

one (A), the zinc, is called the anode, and the negative (B), or copper, is called the cathode. You should keep these terms in mind.

"The liquid in the cell, marked C, is used as the electrolyte, and for that we shall take some of the sulphate of copper which the copper ore furnishes. A good strong salt solution would also answer the

purpose. The two electrodes are separated, and a wire connects the two outside of the cell. Now you will notice that within the cell the current flows, as shown by the dart E, from the positive to the negative plate, but outside of the battery the current flows through the wires F from the negative to the positive plate."

"I can understand it now. The current from the battery will always go from the negative to the positive pole."

"You are mistaken. I am glad you referred to that. It shows the importance of using correct terms. You must not confound the terms 'negative plate' with 'negative pole.' All currents leave the battery or dynamo from the negative plate, but that negative plate is called the positive pole of the dynamo."

"It seems to me that is a curious way to do it."

"Such is the case, however; but there is no real positive or negative in the alternating current, so that either side may be termed positive or negative."

Work on the battery continued for some days, as lack of fine tools made much of the work difficult, and in doing this work, as in everything else, a certain amount of preparation was necessary. They had no screws, and no facilities for making them, so a substitute had to be devised, but the difficult part now to encounter was the preparation of the wire.

"A battery is of no use unless we can have wire, and it will be a big job to beat out wire long enough

for our purposes," Harry observed as the battery neared completion.

"Then we must draw some wire?"

"From what?"

"From the copper?"

"Is that better than iron?"

"Copper should be used for several reasons; first, because electricity travels through a copper wire more easily than through iron, and second, for the reason that copper is more ductile than iron, and can be drawn into a wire with greater facility."

"Doesn't electricity flow through different substances at the same rate of speed?"

"Yes; but it retards the amount or the force."

"You say, 'Amount' or 'Force.' I can understand that if applied to water, that there might be a large or small quantity of water, or a greater or less pressure, but I do not see how this applies to electricity."

"In measuring the pressure of water, calculation is made by taking the height of the water in the tank. For every 28 inches in height a column one inch square weighs one pound. This represents the force of the water when it issues from the orifice below. Now the orifice may be large or it may be small. The amount or quantity which flows out is dependent on the size of the opening. Electricity is measured in a somewhat similar manner. What is called 'Volts' is the same as the force in the tank—that is, voltage means the pressure. Amperage, on the other hand, refers to the amount of current which is passing, and a greater quan-

tity will pass over a large wire just the same as a greater amount of water will flow through a large than a small pipe. Is this perfectly clear to you?"

"Yes; I understand the difference, now."

The drawing of wire is not a difficult task where facilities are at hand, but it must be remembered that all their tools were of the crudest kind. Harry had prepared a number of bars of copper, each having been beaten out to form pieces about ten inches long and a half inch thick. A steel plate about three-eighths of an inch thick, two inches wide, and six inches long, had a number of holes bored through it, the largest hole being a half

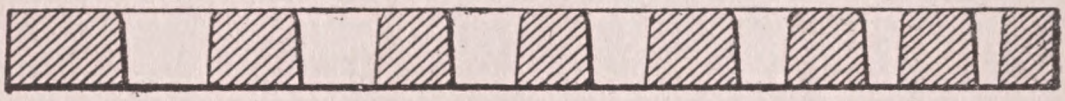


Fig. 26. Template for Drawing Wire.

inch in diameter, and gradually increasing in size, the smallest being about a sixteenth of an inch in diameter.

When all was ready Harry was instructed to hammer out one end, so it would go through the largest hole. The projecting end was then grasped by a pair of heavy pliers, and pulled through, so that the bar was formed the size and shape of the first hole, and of course the bar was lengthened. The end was then hammered out so that it would go through the next smaller hole, and the same process was repeated, and when the wire got larger they had a tool which pushed the wire in at the same time it was being pulled out at the other side.

It was laborious work, and a long time was consumed in fully drawing out each bar. In this way a quantity of serviceable wire was prepared.

"Why does this plate get so hot when we pull the wire through?"

"Why do you make a fire by rubbing together two substances?" replied the Professor.

"On account of the friction."

"For that same reason you are making the heat in drawing the copper through the die."

"But I notice that if I hammer a piece of cold iron it will get hot. There is not any rubbing motion there to make friction."

"Do you think not? You have by that means made the most intense friction. The iron is composed of tiny particles, called atoms, and molecules. When you strike a piece of iron you force these particles in among themselves, and the friction caused by this movement produces the heat."

"Is that true of all substances?"

"Yes."

"Well, if air is forced together will it heat in the same way?"

"Yes, and for the same reason. The tiny particles, of which air is composed, move among each other with such rapidity, under compression, that the heat their frictional contact develops is dependent on the pressure exerted."

"You used the terms 'atom' and 'molecules' a moment ago. What is the difference between them?"

"A molecule is always composed of two or more atoms. An atom is smaller than a molecule, for

this reason. Furthermore, an atom comprises only one substance. A molecule has two or more substances in its make-up. For instance, water is composed of two parts of hydrogen and one part of oxygen. One molecule of water, therefore, has three atoms, two of the atoms being hydrogen, and one atom oxygen."

"Baby," the infant orang-outan, had now grown to be a pretty good-sized boy. He would sit at the table and gravely eat with a knife and fork, which he had learned to handle most intelligently. In the various trips which had been made from time to time, the Baby was kept at home, but on more than one occasion he would follow up the wagon, and would as often be welcomed when he did come.

Harry found a good use for him later on, and from that time forward Baby knew that a jaunt into the forest meant a trip for him as well. When it came to tree climbing Baby was in his glory. He would swing from branch to branch, and shake the nuts, and the amusing thing was to see him help gather and throw the nuts into the wagon, in the most business-like fashion. He was never known to laugh, but they had many occurrences which, no doubt, made him smile in his own way.

George was an adept cook. He was fond of making surprising delicacies, and boy-like, they were always the kind that had honey of some sort in their composition. Without any knowledge of cooking, but knowing, in a general way, that eggs and milk were the principal things used in puddings, it was not long before he was regarded as the chef. Baby was sure to be present whenever

George occupied the kitchen. And help! Why certainly! He knew what flour meant, and particularly honey. The truth is, that he knew what that meant if George merely looked in the direction of the honey pot.

And talking about eggs! Harry found out about this accomplishment in Baby. In the tall grass beyond the barley fields were flocks of prairie chickens, and during one of the hunting expeditions he found several nests of eggs. They are just as much more delicious than the common egg as the prairie chicken is more delicate than the hen. Baby never thereafter forgot the eggs. Singularly, he never ate any of them. Apparently the orang does not crave them in his native state, but the little rascal had an eye to the good things, and when he saw the eggs go into the pudding and cake, there were no scruples on his part.

George had been planning a surprise for the Professor. In many devious ways he learned his age, and August was the month, so in concert with Harry, planned to treat the Professor with a birthday party, the first real attempt at jollification which had been proposed since they landed.

"I remember, he said he would be sixty-five years old on the tenth of August."

"But the trouble is, we don't know when we get to the 10th of the month."

"The chances are he doesn't know, either. But what difference does a day or two make, anyway?"

Among the delicacies which George had prepared were 65 little sweet cakes, because they

couldn't put that many candles on the big cake, and the boys knew, from experience, that they would have to use candles, or something else to typify the age."

The "tenth of August" came, and the Professor, in all innocence, proposed a day for hunting. Both boys opposed this, to his surprise. The Professor did not press the matter. As usual, when at home, he was shut up in what they called the laboratory. Even though he should be present in the kitchen he would not be likely to take notice of any extra preparations.

In the meantime Harry had made a bell out of a flat sheet of steel. It was really a gong. When the noon hour arrived and the table had been set ready for the symbolic cake pyramid of little cakes, George ordered the gong to sound, and Harry made such a frightful din with the unexpected noise, that Baby was terribly frightened, and scampered to the loft, his usual place of retreat when reproved or unduly excited.

The Professor was out of the laboratory like a shot, and hurried over to the house. At the same time George returned. "Who has taken my cakes?" he cried. "There are less than a dozen left." Baby chattered in the loft. The Professor could not understand the commotion. All he knew was that Baby was swinging along the rafters and that George was flying around the kitchen hunting cakes.

"Hello, and what is all this? Expecting company?"

"Yes; this is a birthday party."

"That is a good idea. I suppose you have invited all your friends?"

"Yes; we have invited all we know; just one."

The Professor did not need to be told any more than this. His eyes filled with tears, the first real thing that the boys ever saw on his part that strongly affected them, and when the Professor, his heart so full that he could not speak, silently looked at them, they forgot the feast, and the cakes, and Baby. They thought of home and of what they were doing there, and whether the time would ever come when they might be rescued.

Brave Harry was the first to recover. Like a veteran he grasped the Professor by the hand, and wished him many a happy return of the day, and George, though not so demonstrative, joined Harry in this wish and prayer. Just then one of George's cakes fell at his feet. He picked it up and Harry glanced at the Baby. The mysterious disappearance had been solved.

No! Baby was not spanked. He came down without any coaxing, with several of the cookies in his hand, and gravely took his place at the table. What a very narrow margin there is between tears and laughter. They roared as though such a thing as tears were unknown.

When they recovered from their fits of laughter, and attempted to proceed with the feast in some semblance of order, a glance at Baby was sufficient to start them up anew. And here a surprising thing occurred. As before stated, he never had been known to laugh. But now Baby laughed, for the first time. And then the boys and the

Professor knew that this was also the first time they had indulged in a hearty laugh.

"You may say what you please," said the Professor, "but laughter is infectious. How much farther a smile will go than a frown. And this reminds me of a very curious thing in nature. What are called perfumes have been known to carry through the air for ten miles. The odor from the balsam-yielding Humeriads has been perceived at a distance of four miles from the shores of South America; a species of Tetracera sends its perfume as far as that from Cuba, and the aroma of the Spice Islands is wafted many miles to sea. Now the singular thing is, that vile and injurious odors are not carried such distances."

"Why not?"

"For the reason that the oxygen of the air destroys the bad odors."

"I thought of this when we were laughing here so merrily a while ago. Laughter is like a perfume, it goes a long way and does not need a purifying agent; but the harsh and angry word is like the evil smelling substance, which needs to be purified."

CHAPTER XI

THE GRUESOME SKELETON

The merry party lingered long over the meal. Roast prairie chicken was the chief dish. The Professor had found lentils, and this, with potatoes, or cassava, formed the principal dish, to say nothing of the sago pudding and the residue of the little cakes which just suited Baby's palate.

For drink there was plenty of cold water, fresh and sparkling, obtained from a natural spring not far away. The Cataract River furnished a good water, in the sense that it was clear, but it had an unpleasant taste at times, so for all cooking purposes the water used had to be carried from the spring, which was sometimes burdensome.

"I wish we could purify the Cataract water, as it would be a great convenience," was George's remark, when they were considering their work and duties.

"We can easily do that by using the chips of the common oak tree or the charcoal can be used, as I have before stated."

"It is a curious thing that oak chips will purify it. Does it act in purifying the same way as charcoal?"

"We used oak bark for the purpose of tanning leather because of the tannic acid it contained. The chips of the wood contain tannic acid as well, and it does the same thing to the impurities in

water that boiling does—namely, it coagulates it. In Egypt, the muddy waters of the Nile are clarified and purified by using bitter almonds. In India, they use a nut called the Strychnos for this purpose."

"It seems people everywhere had some idea of purifying drinking water."

"Yes, and through all ages; even the Bible speaks of it."

"Where?"

"The Book of Exodus. I think the fifteenth chapter, says:

"'So Moses brought Israel from the Red Sea; and they went out into the wilderness of Shur; and they went three days in the wilderness and found no water. And when they came to Marah, they could not drink of the waters of Marah, for they were bitter; therefore the name of it was called Marah. And the people murmured against Moses saying, What shall we drink? And he cried unto the Lord, and the Lord showed him a tree, which, when he had cast into the waters, the waters were made sweet.'"

"Our Cataract water, flowing, as it does, largely through forests and past vegetable banks, takes up a large quantity of albuminous matter, which is so great in quantity that the atmosphere, or the oxygen in the air, cannot purify it by the time it reaches us, so that if any astringent matter like oak, or birch, or beech, or even alum, is put in the water it will cause the albumen to precipitate. In the district of La Gironde, France, the waters of the Landes are naturally very impure from

these causes, but since the cutting and floating down of the immense oak forests, the water has been made sweet and wholesome."

"Isn't all this curious and wonderful to think about?"

The work of preparing and putting into practical form the primary electric battery was going forward steadily, and at the Professor's suggestion a number of cells were made, which it might be well to describe briefly.

As the clay was the only available material, each cell had to be made rather heavy and clumsy in appearance, and was baked when completed. Each was ten inches deep and three by six and a half inches within. The electrodes, made of zinc, were each one-half inch thick, six inches wide, and nine inches long. The copper electrodes were the same dimensions, except that they were a quarter inch thick. These were stood in the cell, a short distance apart, and held in position by means of notched wooden blocks.

When all this was completed the cells were filled with sulphuric acid that had been made from the copper ore. It was, of course, much diluted with water, so as not to make it too strong.

"What is the object in making so many cells?"

"So as to get the voltage."

"Does the voltage depend on the number of the cells?"

"Each cell gives practically two volts, so that if we have 20 cells there will be 40 volts; 30 cells, 60 volts, and so on."

"But where do the amperes come in?"

"That depends on the size of the plates forming the battery. Surface is required for amperage, and quantity of plates for voltage."

"Suppose I had plates the size of this table, wouldn't I get more electricity than if I had the plates cut up into smaller pieces?"

"Electricity means both volts and amperes. There is no such thing as electricity with one of those qualities alone. A current may have 2 amperes and 40 volts, or 40 amperes and 2 volts. Multiplying the volts by the amperes gives what

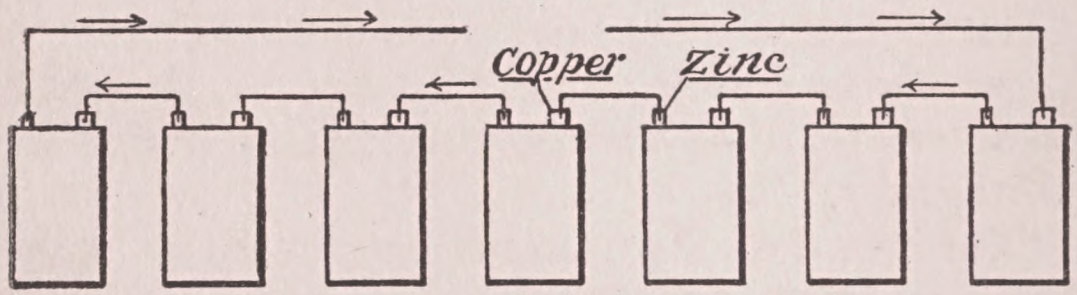


Fig. 27. Complete Battery with connections

is called watts, and there would be 80 watts in each case."

The determination of the boys to build a new and better boat than the old one was now manifesting itself in plans, which were considered. George was in favor of building a large vessel, by means of which they could sail anywhere they wanted to; but Harry and the Professor opposed that plan, for several reasons. Harry, particularly, objected.

"I am just as anxious as George to build a large boat, but the difficulty is that to do so would take a long time, longer that we ought to take at

this time. Furthermore, a large vessel would be hard to manage with our small crew, as we would have to make it a sailing vessel."

"Then why not make it a steam vessel?"

"That would make the job still harder and longer."

"I think Harry is quite right. A boat but little, if any, larger than the one we built, would be the most serviceable. If the one we made had been smaller, or lighter, we should have been able to carry it around the falls. Instead of that we had to leave it there."

Harry insisted in his views. "What we can do with our present supplies is to build a boat, even larger than our former one, and make it still lighter."

"Yes," said the Professor; "we now have lumber which is dried, and with the improvement in the tools we can turn out a boat which will be a credit to any community."

That question settled, the plan of the boat was drawn up. It was decided to build the boat on the general plan of the former one, as to size, namely, from sixteen to eighteen feet in length, and at least five feet wide, with a flat bottom, the prow to be contracted, and the bottom of the forward end to be bent upwardly, as much as their material would permit of bending.

For this purpose Harry stated that the body of the boat would be made of double thickness of material, as their sawing machinery had been so much improved that they could cut it into five-eighth inch lumber, and in that way the joints

could be lapped, and the sides and bottom more easily bent into the required curves to make a graceful-looking boat.

The sawmill was at once put into good working condition, and within a week the principal parts of the boat were ready to be assembled.

"In your next weekly jaunt, I suggest that you might get our old life-boat. We should not neglect our friend."

The Professor's suggestion met with a hearty response, and on the following day the boys were off early to bring the boat to the Cataract.

First going to Observation Hill, which was the custom of one to do each day, they crawled up the rocky sides, and surveyed the horizon. From that position they could see across the neck of land, east of the Cataract, to the point southeast; to the southwest was the mountain range; to the west the forests, and to the northwest the irregular cliff line, which ended with another projecting point several miles beyond. Along the sea line this was the limit of their knowledge.

"While we are here let us examine the sides of Observation point and try to find the old flagstaff. I still think it was blown away."

Harry's suggestion was acted upon, and they made the trip together over the rocky side toward the sea. Observation point was on the mainland, and formed the extreme northern limit. It was fully half a mile from the grim rock where they had been wrecked. Between the two points were detached rocks which sprang up out of the water, and in which the water was constantly swaying

to and fro. When the sea was heavy these rock islands made navigation among them a dangerous occupation.

The tide was then coming in, and eddies and cross currents were rushing hither and thither, so that it was easy to see that to float the wrecked life-boat it must be taken out to sea around the rocks. They hesitated to do this under the circumstances.

All sides of the hill were now examined with care. As they were about to leave the hill and go to the point where the life-boat lay, some wreckage was discovered below them, caught within the clefts of the rock. Here, packed in with seaweed and brush, was an object which interested them.

"What is this, George? It looks like the fragment of a boat; and here is another piece. Let us dig it out."

Both were excited beyond measure at this discovery. Not only one, but a number of pieces were finally removed. It was, beyond question, portions of a boat.

"Harry, this is part of our boat. See this piece of rope; and here is part of an oar. Wait till I get to the bottom of this mass."

"Run for the Professor, and I will remove the pieces while you are away," was George's answer.

Harry was off at the instant, and in less than half an hour, reappeared with the Professor, who examined the recovered portions of the wreck.

"It is certainly parts of a boat; but I am sure, from the present examination, that it cannot be our boat."

The boys were surprised at the information.

"My reasons for saying so," continued the Professor, "is, that the pieces here are not part of a life-boat, such as our craft was, although it was a part of a ship's boat. Where is the stern portion of our boat that you found? Let us get that, and we will be in a better condition to judge."

"We landed it beyond the point where Harry first reached the shore the day we were wrecked."

"Let us get it at once."

In less than a half hour the broken portion of the boat was landed at the foot of the cliff in front of Observation Hill.

Harry now had no doubt that the Professor's observation was correct. "See, this has no double hull, which the life-boat has, and no part of these pieces can be made to fit. Look at this stern. All of the stern post is still on the boat below."

It was, undoubtedly, another boat; but there was no name or number on any of the pieces by means of which it could be identified.

"I believe it was a part of the *Investigator's* equipment," was the Professor's final conclusion. "Have you recovered all the parts from the debris?"

"I don't think we can find anything else. While Harry was away I hunted all along the point in the hope that some more pieces might have been found."

The most minute examination was made for some mark of identification, but nothing was found which would give the least clue.

"Let us gather all these pieces and keep them

for further observation, particularly for the reason that other parts may be found eventually, and identification will then be easier."

"Shouldn't we take the remnant of our lifeboat to the Cataract?" asked George.

"By all means. It has just occurred to me that we might use that as part of the new boat we are building."

That was an idea which had not occurred to either of the boys. Considering that the portion recovered was the stern, and by far the largest part of the vessel, and that it had the double hull construction, made the suggestion a most acceptable one.

After all parts of the wreckage had been assembled, the Professor, accompanied by the boys, made another tour, much to the left, and on returning to the boat, the Professor's eye caught a white object lying partially hidden behind a rock.

"What is that by the rock to the right?" Without waiting for a further suggestion from the Professor, Harry made his way up, and when the object was reached, threw up his hands, without uttering a word. George had followed, and before the Professor had time to reach the spot, he cried: "A skull!"

"There is more than that," said the Professor. "Remove the debris."

The boys saw portions of the skeleton plainly now. It was such a shock to them that they could scarcely speak.

"Probably that solves the mystery of the wreckage we found."

"Undoubtedly," was the Professor's only comment.

The boys were now absolutely unnerved, but the Professor, without noticing their agitated state, carefully removed the seaweed and other accumulation, and found the skeleton largely disjointed, excepting the torso, or upper portion of the frame.

When the entire skeleton had been taken out

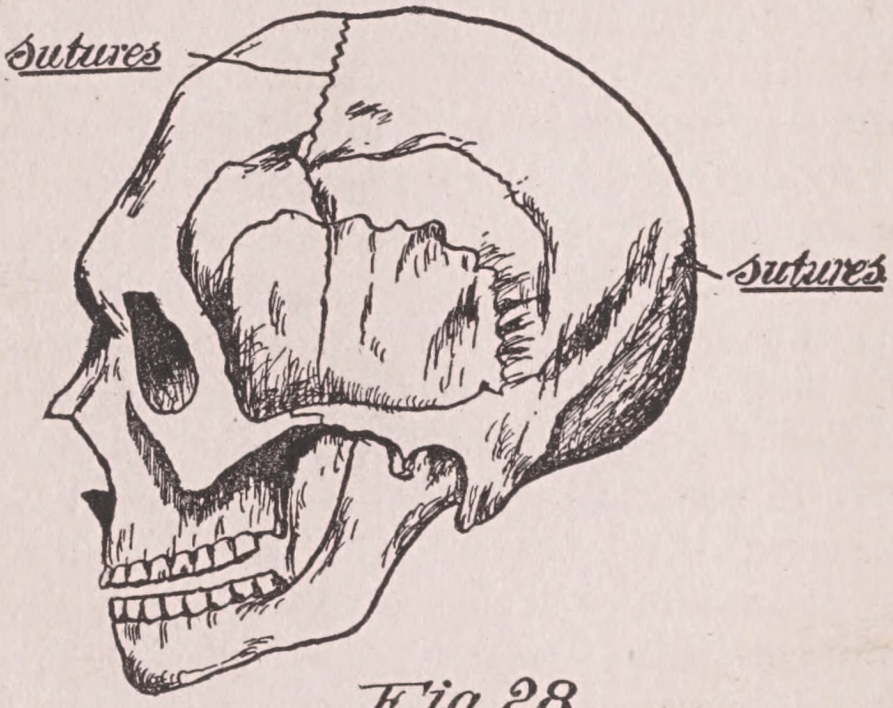


Fig. 28.

HUMAN SKULL

and arranged, the Professor said: "It seems we are to have one mystery after the other."

"How long do you suppose this body has been here?"

"Probably ten months or more."

The boys looked at each other. "Ten months? That is as long as we have been here."

"That is one of the reasons why I said ten months."

The boys knew what that meant. This was, very likely, one of the *Investigator's* boats, and the skeleton the remains of one of their shipmates.

"Probably it was one of the boys," was George's inquiry.

"I do not think so," said the Professor. "The skeleton shows that of an individual past middle age."

"Why do you think so?"

"Principally, from my examination, so far, on account of the condition of the skull. You see, these saw teeth lines, which cross the top portion. These are called the sutures, and in infancy they are not joined. Before the third period of life these joints grow together, so as to form an undivided skull. But wait; here is another indication. The teeth seem to be greatly worn, showing that the person must have been close to the sixth period of life."

This discovery was the cause of very conflicting emotions in the boys. They reverently gathered the bones, and at Harry's suggestion the boys went to the Cataract for the team. The Professor volunteered to remain.

We may well imagine the feelings of the boys as they went on their mission. Here was mute evidence that others of the ill-fated ship had met disaster. They had often speculated on the fate of their companions. How many had been left to tell the tale!

The yaks were yoked, and taking with them a rude box, which had been put together, as the Professor suggested, they shortly returned.

"Have you found anything new?" was George's first question.

"The poor fellow was undoubtedly killed when he landed, and I think he was a sailor."

"Have you found anything which makes you think so?"

"Nothing but what you see before you. That break in the skull was, in my opinion, made by contact with a rock; furthermore, several of the bones were broken, as you see, at the time he met with his calamity; and one of the legs shows where it was broken before his death, and had mended."

It was a remarkable funeral cortege which wended its way slowly back over the hills to their home. They felt it was paying a tribute to a friend and companion. All doubts on their part had been dispelled. He had been one of their companions on that terrible night when the explosion had sent their ship to the bottom, and had cast them adrift on a sea which welcomed them in raging fury.

"What shall we do with the skeleton?"

The Professor was silent a long time before he answered. "I do not know what to advise. Perhaps, in the future fate may be kind enough to restore us to our homes and friends, and if it should be that we are the only ones so rescued, the skeleton would be a positive means of enabling us to ascertain whether or not he was one of our companions, and also to advise his friends."

A stone sarcophagus was built, in which the remains were deposited after a funeral service at which the Professor presided.

This event had a most depressing influence on the boys, as well it might, during the entire day, and it was the principal topic of their conversation while together. During the two days following only brief references were made to the Professor, but the second evening George's inquisitive nature could not hold in any longer.

"When we were on the rocks examining the skeleton, you referred to the fourth and the sixth ages of man."

"Yes; in point of growth man has seven ages. The first is infancy, which ends at the second year; second, the age which ends at the seventh year; third, at the end of fourteen years; fourth, at the end of twenty-two years; fifth, at the end of forty-seven years; sixth, at the end of sixty-five years; and seventh, which ends at death. These divisions vary somewhat between males and females, and I have given you merely the average between the two sexes."

"I can't help feeling sad, when I think of the things that have happened, and at the thought that all our friends may have been lost."

"Sadness is a natural feeling under the circumstances, but after all, why should it be so? Why should the sight of the skeleton bring sorrow to you? Probably the Egyptians had the right idea when they always had a skeleton at the feast."

"Skeleton at the feast? What was that for?"

"As a reminder of death?"

"There is one thing I could never make myself understand. Why is death necessary? Why

couldn't man have been made so he could live always?" was Harry's query.

"You have asked a very broad question. It is one which has a great many answers. At this time I shall give only one of the reasons. The earth would not be big enough to hold the people. I do not know the population of the globe today. It is about 1,000,000,000; and if we take the age of the earth at only 5,000 years, we should have in that time 125 generations, counting each generation as 40 years. Do you know what that would mean in population at this time? You could not comprehend the figures. Let us take the United States alone, as an example. Assuming that the population is 90,000,000 at the present time, and that the natural rate of increase is only double in each forty years. This is how it figures out: In forty years we would have 270,000,000; in eighty years, 810,000,000; in one hundred and twenty years, 2,430,000,000; and in one hundred and sixty years, 7,290,000,000. At that rate New York City would have 480,000,000 of people, and its boundaries would take in the whole of the State of New Jersey and nearly half of the entire State of New York, as thickly settled as that city now is."

CHAPTER XII

THE DISTANT SHIP AND ITS DISAPPEARANCE

"What is that weed you have, Professor? The root looks like a parsnip."

"It may be something we can drink."

"It looks just like a weed that grows all over our farm at home."

"I have no doubt of it. This is the endive, as it is known in the States, but it is really chicory."

"I have heard of chicory; isn't it used as a substitute for coffee?"

"Principally on account of the bitterness in it. The French make the greatest use of it, because they claim it gives strength to coffee."

"What part of it is used?"

"The root; the bulb you see here, and they have a curious way of preparing it. The root is dug up before the plant shoots into flower, and is washed, sliced and dried! it is then roasted until it is of a chocolate color. Two pounds of lard are roasted with each hundredweight; and afterwards, when ground and exposed to the air, it becomes moist and clammy, increases in weight, and smells like licorice. When put into cold water it gives a sweetish bitter taste, not unlike coffee."

"Let me try some of it, and don't say anything about it to Harry. And now, while I think about it, why couldn't we make some crocks out of our clay, so we can use them for our milk. We can't

put them in the copper vessels and the iron is just as bad."

"That is a splendid idea; and you might as well vitrify them."

"What do you mean by vitrifying them?"

"Putting the glaze on them, just like the common crocks have."

"That would be simply fine."

The Professor explained the process, which consisted in making the crocks out of the best clay available, and then burning them. Afterwards an intense heat must be made in the furnace, and after soaking the crocks in a strong solution of salt brine, they must be put in and burned again; the greater the heat, the better.

The boys started at this with a will, and when they had arranged to make the crocks they found it most difficult to put them into a round and uniform shape.

"I would suggest that you make a potter's wheel for that purpose."

"A potter's wheel? What is it like?"

"It is the simplest thing imaginable. Do you think, Harry, you could turn out a wooden vessel just the size of the outside of an ordinary milk crock, and turn it with a central stem below, and also have a little pulley on that stem?"

The Professor made a drawing (Fig. 29), which shows just how he wanted it made. In the drawing, A is the cup-shape, which is the size and shape of outside the crock; B is the central stem; and D is the small pulley on the stem. This was mounted

in a pair of arms like CC, and a belt was attached to the pulley.

"You have made a very creditable article. Now you may make a flat paddle, and shape one end so that it will be just like the inside of the crock."

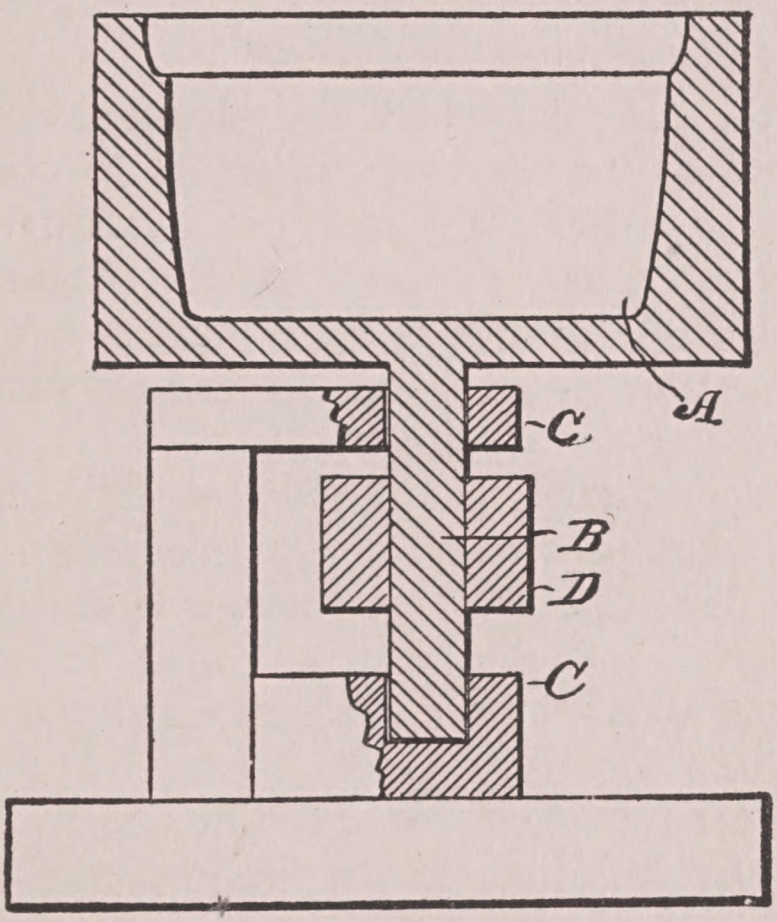


Fig. 29. Potter's Wheel.

The drawing (Fig. 30) shows how it was made, with a cross handle at the upper end.

That day the crocks were turned out in the following manner: The potter's wheel was rotated about sixty turns a minute, and the clay, in a plastic state, was put in the cup-shaped top, and the hands used to force the clay up the side

wall. When the crock was formed in as even a manner as it could be by hand, the blade described was used to make the interior uniform.

The potter's wheel is one of the oldest tools known. Its use can be traced back for more than four thousand years, when it was well known by the Egyptians.

Since the day that the boys visited Observation Hill, at the time they discovered the skeleton and fragments of the boat, no attempt had been made

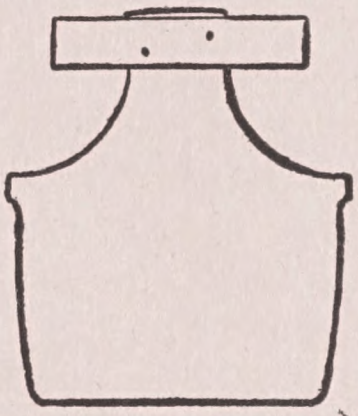


Fig. 30. Forming blade for inside of Crock.

to visit the cave. That was the mission when they accidentally made their surprising discovery.

George did not, however, feel that they should again make the attempt until they had a better lighting means than the unsatisfactory candles, and when the supposed petroleum vein dashed all hopes of lighting material from that quarter, the only remedy seemed to be by way of improving their candle-light.

Harry had progressed well in the making of the battery. It was now in a completed state, and he announced that the first tests would be made the

next day. In the morning all assembled in the factory, and the sulphuric acid solution was made up.

The Professor inspected the batteries. Ten cells had been prepared, so that they could have, at least, fifteen volts. When all the cells had been connected together—that is, the positive pole of one cell with the negative pole of the other—a wire was attached at each end of the row of cells, at the last electrodes, so as to form the outside connections.

When the two outside wires were brought together and their contact broken a spark was plainly shown, which was an indication that the battery was generating electricity. The boys danced about with joy at this exhibition. From that time forward the battery was one of the most interesting things in the laboratory, and what they finally accomplished with it will be fully detailed as we go along in their history.

George thought he saw a way to make the light necessary for the cave. "Why can't we rig up an electric light now and explore the cave?"

"We might do that, but we have several things to do before we can have light from that source."

"Haven't we the electricity for it?"

"Do you know how many years electricity was known before electric light was discovered? Before we can utilize this agency for lighting purposes, we must make a machine which will produce a vacuum; we must make glass; we must learn to carbonize threads; and the art of blowing glass would be a necessary accomplishment."

"As usual," said Harry, "something must be made to make something that makes something else."

"But can we make electric light without putting it in a glass bulb?"

"Yes; we can make what is called the arc light; instead of the incandescent."

"What is the difference between the two?"

"In the incandescent, such as we talked about making, a thin carbon filament is enclosed in a glass bulb, from which as much air as possible has been exhausted, and when a current of elec-

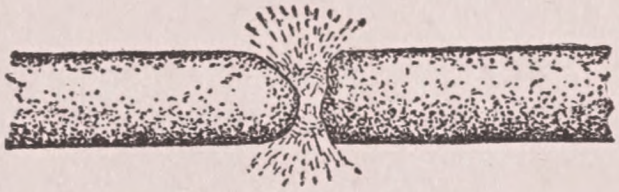


Fig. 31. The Electric Arc.

tricity passes through this filament, it is heated up to a white heat."

"Why doesn't it burn out?"

"It does burn out in time. What preserves it, however, for a long time, is that most of the oxygen has been exhausted from the bulb——"

"Oh, yes; I know, there must be oxygen to support combustion, so that the carbon is merely heated up?"

"I am glad you remembered that. The arc light, on the other hand, depends on an entirely different thing. You have seen, no doubt, the long black pencils used in the large lamps. That

is carbon also, made out of ground coke, molded and compressed into shape."

"What does arc mean?"

"Did you notice that when we put together the two circuiting ends of the wires in our battery this morning, we could not notice the existence of a current, but whenever we pulled them apart we had a spark?

"Let us now make a little experiment which will show you the arc. You see, I am making a sharp point at the end of each wire, and I will fasten one of the wires so it cannot be moved. Now the other wire will be placed with its point as close to the other points as possible, and so fixed to the support that we can adjust it still closer and hold it. See, the points now touch each other. I will move one of the wires the slightest distance away from the other. There! see the light?"

"But it goes out in a little while; what is the cause of that?"

"The electricity has been burned off the end of the wire, and the distance is now too great for the electricity to jump from one to the other, so they must be moved closer together. That space between the ends of the two wires is the electric arc. Instead of the two wires the carbon pencils are used."

"But how are the two carbon pencils kept apart at the right distance at all times?"

"That is what the invention of the arc light consisted in; to find a means whereby the current itself makes the adjustment necessary to fur-

nish a steady, constant light. When we start to make the arc light the mechanism can be explained."

George's scheme of the electric lamp for the cave had vanished. But the cave must be explored. He was determined on that point.

The yaks were brought out and a start made for the cliffs. After unhitching them from the wagon and unyoking the animals, so they could feed in the meantime, the oil lamps were taken out and carefully examined. The Professor had suggested the advisability of carrying with them two of the spears, which, it will be remembered, formed part of the weapon equipment of their last voyage, and those, with the guns, were considered sufficient for any foe likely to be in the cave.

Harry, on this occasion, volunteered to mount Observation Hill for their daily trip of observation. He returned by the time the yaks were disposed of and the implements prepared, as stated.

"I suggest," said the Professor, "that we keep constantly on the alert now for any vestiges of driftwood, or other objects which we are likely to find along the shore."

As a result the progress was slow, and the scrutiny keen on the part of all. As they rounded the last large projecting rock, just before entering the gorge which led to the cave, Harry jumped on a rock, waving his hand, and crying, as he pointed seaward: "A sail! A ship! See it?"

The agitation of George was beyond all description. Harry kept repeating the words. He was entirely beyond control.

"Be calm; do not become excited. Harry, you are the most nimble; run to Observation Hill: here take the large sheet in the wagon; wave it there, and keep up the signaling; they may see you."

The ship, although far away, was plainly made out, but its character could not be determined. It was evidently a large sailing vessel. Just imagine what must have been the feelings of the party at the sight of the ship, although so far away. Would they see the signal?

In the commotion that followed, what was the Professor doing? He quickly placed two stakes in line with the ship, and watched it patiently. "It is moving to the west."

George's curiosity induced him to look over the Professor's shoulder, and thus enable him to follow the movement of the boat, and by means of which he could see the sails slowly move past the distant stake.

The Professor scarcely moved. "What is Harry doing? Is he still signaling?"

"Yes; he hasn't stopped since he reached the hill."

The stake nearest the Professor was again moved over a trifle as the ship moved on, and they watched and waited.

"Why, the ship hasn't moved for the last ten minutes."

"It seems not," was the Professor's response. Again they waited. George walked to the stakes and back again. He stepped aside to look at Harry on the hill, and again returned to the observation stakes.

"Singular that the ship hasn't moved in twenty minutes or more."

Then, enthusiastic at the mere thought, he cried out, as he ran toward the Professor: "Do you think they have seen our signal? Have they stopped; and are they returning?"

"Either that or they have changed their course, and are now leaving us dead ahead."

This was a blow to the poor boy, whose hopes, brought about by the apparently checked motion of the ship, were now dashed to the ground, when the Professor continued: "They are sailing away, I am sorry to say."

He left the observation stakes. Poor Harry was still signaling frantically. The Professor told Harry that further effort in that direction would be useless, and he slowly and sadly came down the hill.

They looked at each other most sorrowfully, and the boys could scarcely restrain their tears, while the Professor carefully avoided their gaze, or seemed not to notice their grief.

"It is one satisfaction to know," said Harry, as he dolefully looked across the broad sea, "that vessels do come this way, and that it is not out of the world entirely."

George quickly recovered. "Why not make a big signal flag for Observation Hill?" This was seconded by the Professor.

"And while we are about it why not make a good old American flag?" was Harry's comment.

The cave had been forgotten in this incident. When their wondering and questionings had

ceased, the descent was made around the point, and the entrance soon reached.

The two lamps were now lighted, and the explorations began.

"I think it is advisable," was the Professor's first observation, "that we go in a hundred feet or so, and then mount one of our lamps in a conspicuous place. We can then proceed with the other as far as the water, and if any accident happens it will not cause trouble to both of the lights. We can always have one of them to fall back on."

When they had gone the distance determined on, a secure ledge was selected, and Harry placed the light so it would cast its beams along the cave.

"Be careful now, we are near the water."

The Professor had now the other light, and the boys led the way, so the beams from the light shone past ahead of them. They went beyond the point where the water had been found previously, but there was no sign of it. The course of the cave now changed to the right, and the floor of the cave went downwardly at a slight descent.

The Professor suddenly restrained the boys. "Wait a moment; the light behind us should be brought forward to this point."

George went back and brought it up, and after some delay a place for it was found. The two lights now plainly showed a sudden enlargement in the area of the cave, and above them hung what appeared to be huge icicles, giving the interior a weird appearance. Still no water was in sight.

"The white substances we see all around us indicate that above us the rocks are limestone, and water, in coming through, has acted on the stone so as to form carbonate of lime, or chalk."

The single lamp was now sufficient to light up the interior, which looked like a domed iceberg, with all sorts of fantastic figures standing out in bold relief, which were contrasted by the many dark recesses irregularly scattered about everywhere.

"I see an opening beyond," was Harry's remark, in a suppressed tone.

The contracted opening was to the left, and he quickly made his way over the uneven floor to that point. "The water is beyond, and I hear something there."

George quietly moved forward. The light from the Professor's lamp glistened on the surface, and rippling waves were easily distinguished.

"What has become of the light we had on the perch?" was the Professor's startling inquiry.

The boys looked back. It was not there. Probably it had gone out.

"We must not go on until we have relighted it," was the Professor's caution.

George went back. The light from the Professor's lamp still threw its rays back to the ledge, which was not more than a hundred feet from their present location. "I can't find it. It is not here, and I know I put it on this ledge. Here is the piece of lime I put up against it."

Too startled for words, Harry drew back from the opening. Without further conversation he and

the Professor retraced their steps toward George, who was now frantically searching every crevice.

"That is too bad. Are you sure this is the place?"

"I am positive of it."

The boys looked at the Professor. He knew they mentally asked whether they should proceed with the single light. "I think it would be unwise to go farther with one light only. If we can do no better we can make a half dozen lights, and light up the whole cave. I am just as much interested in it now as you are."

They were about six hundred feet from the mouth of the cave, as nearly as could be estimated.

"Before we return we might as well chart the cave, so we shall have some idea of its crooks and turns. Have we anything to measure with? If not, have you a cord, so we can get some idea of distances?"

George held out one of the spears, which was about five feet long.

"That will answer," said the Professor. "Let us call this five feet long for the present. The first thing we must do is to establish a base line. But what shall we do for something to mark our chart on? I haven't a bit of paper."

Here was another difficulty. It would be impossible to make tracings on their clothing. Harry's wit came to the rescue. "I have it. Why can't we break off a piece of this chalk. Probably we can find some smooth piece that will answer."

"That might be done," was George's answer, on reflection; "but what can be used to mark on chalk?"

The Professor was now highly amused. "Can't you think of anything we have here which will answer?"

"I haven't had a pencil, or anything except charcoal, since we touched this wonder island."

"We have something here that is used among all civilized people the world over for marking purposes." The boys opened their eyes in wonder. "I have it here," said the Professor, looking at the lamp.

"The lamp?"

"No, not the lamp, but what is in the lamp."

"The oil? Where can we get anything to mark with in the oil?"

"We have been making a marking material all the time we have been in the cave, and you are just as well acquainted with it as anything you know. It is the soot from the burning oil."

The boys laughed, not at the information, but at their stupidity.

"Yes; the soot is carbon, and the best soot is made by imperfectly burning oil, or fat, or any other fuel which has a large amount of carbon."

The boys found several pieces of flat chalk, one of them a little over a foot long. This was held above the flame of the candle until covered with soot.

"The first thing to do is to establish a base line. This we will mark A on the drawing. Now, starting from the point here where we lost the light,

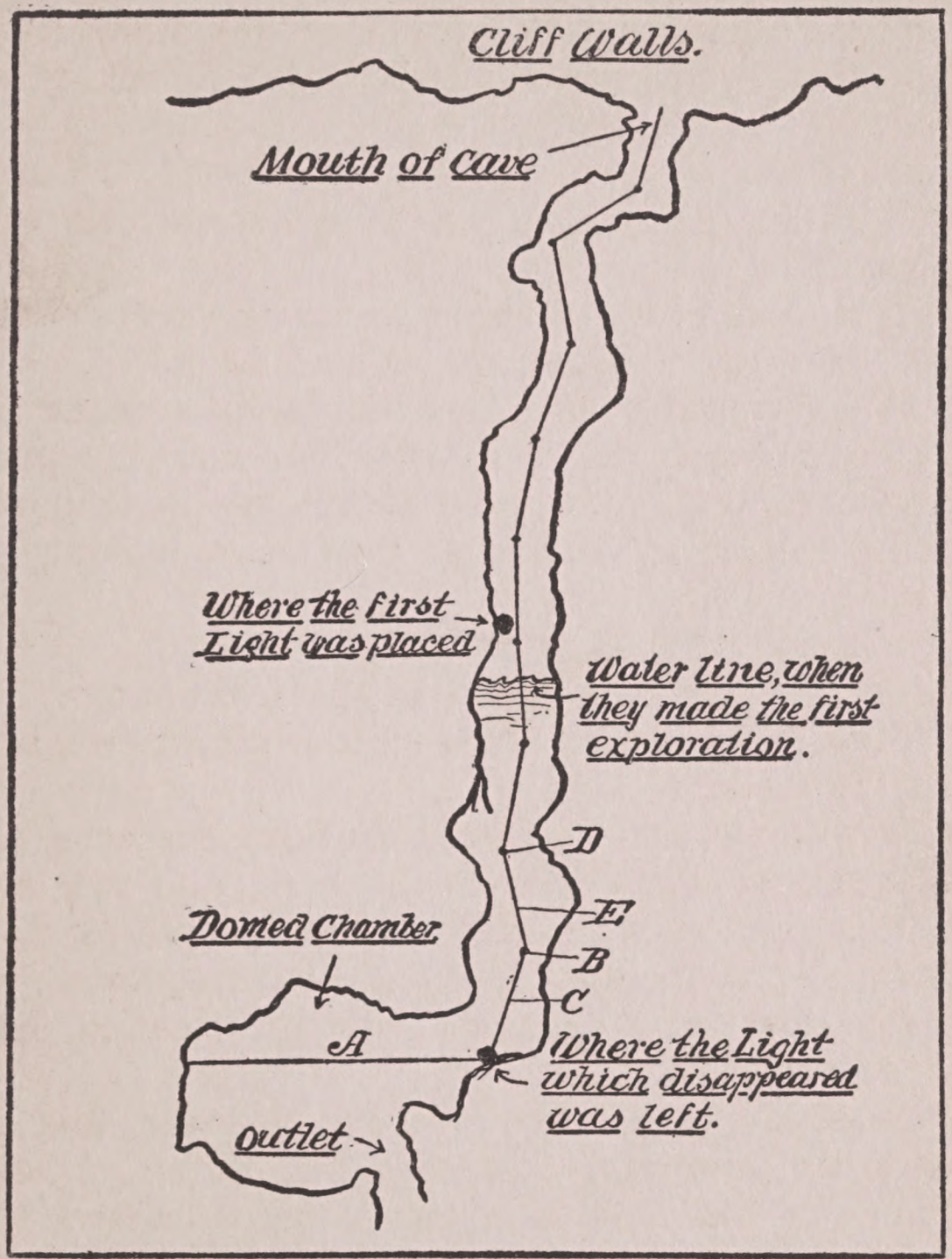


Fig. 32. The Cave, and how it was charted.

you may measure along the line to the west, we will say, until you get to the other end of the chamber. Twenty-five measures of the spear? That makes the chamber 125 feet long, and it is about 90 feet the other way. Let us roughly out-

line the floor plan. Now go out toward the mouth of our cave, and measure off 50 feet. Stop there. You see, I have marked the line A and have laid down the slate slab so that this line is exactly on a line with the one you have measured along the chamber. The point B, 50 feet from here, which you have just measured, makes an angle, C. I will now take the slab to the point B, and you may measure off 50 feet more, and we will call that D. That gives us another angle line, E. You see, at every point we establish a new base line. C is the base line for the line E, and so on all through the cave."

All the measurements were made on the plan outlined, and scratched on the sooted slab.

"One thing more we must observe. As we are marking the successive points, you will notice that I took particular care to observe the side walls of the passageway, so that I could roughly outline them, noting the distances from the various points, and in a crude way marking out the irregularities between the points."

The chart interested the boys so intensely that the disappearance of the light did not again recur to them until they emerged from the mouth of the cave, when it all came back again, with added wonder and speculation. How many more mysterious things would present themselves!

CHAPTER XIII

THE EXCITING HUNT IN THE FOREST

They returned to their home with conflicting emotions. It had been an eventful day. They had a glimpse of the outside world, and an experience below the surface of the earth. Both were unsatisfying. They could explain the one far away on the sea; but the other, close at hand, was a mystery.

"How do you account for the water being so far away from the mouth of the cave?" was George's inquiry after the evening meal.

"Haven't you noticed that we have had no rain for the past five weeks?"

Such was, indeed, the case. The boys had not been observant, like the Professor.

"Evidently the water is supplied from rains, and the floor of the cave permits more or less of the water to leak through, so that, in time, if we had no rains, the cave would be entirely free of water."

"But how about the animal in there; if it is a water animal, how did it get in; and if the water ever dries up, how can it live there?"

"There may not be any subterranean connection directly with the sea, and the animal has been trapped there; or it may be able to reach the sea in the cave at any time, by some underground channel."

"How far do you think the cave goes in?"

"That is one of the impossible things to say. It may extend for miles. Like yourselves, I am curious to know all about it, as soon as we can make further investigations. In the meantime, don't forget about the flag."

"I had forgotten that. I am willing to start on it in the morning. How large should it be made?"

"We should make it a regulation flag, by all means."

"Let me see; how many stripes must we have?" said Harry.

"I know; thirteen."

"Yes; and they must be red and white."

"That is correct," responded the Professor; "but do you remember how many of each?"

The boys were silent.

"The top and the bottom stripes are red, and the intervening ones white. What do these stripes represent?"

"The original States."

"I see you have a pretty good recollection. I remember a class of over forty boys, on one occasion, which had only three boys who recalled that. Then we must have a field of another color, up in the corner."

"That is the blue field, with stars on it."

"Yes; but how many stars?"

"A star for each State."

"And how many States are there now?"

There was no response to this. How many boys or men, even, can tell offhand the number at the present time?

"There were 48 before we sailed. How many, if any, were added since I do not know."

The next day the boys were anxious to set to work on the flag. There was plenty of the ramie cloth at hand, but it was quite yellow. George noticed this, and said: "It seems to me we shall have to be content with making the flag red, yellow and blue, that is, if we can get the red and the blue."

"No," was the Professor's rejoinder; "we must make it red, white and blue."

"But how can we make the ramie cloth white?"

"By bleaching it.' '

That was a new idea; to make white cloth.

"How can we do it?"

"Wet it and put it in the sun. If we want to hurry it up we can use some chloride of lime."

"But where is the chloride of lime?"

"Do you remember that black ore we have in the laboratory, which is called manganese? If we put some of the sulphuric acid on that a gas will be formed, called chlorine, one of the most powerful bleaching compounds known. We can use it in that form, or subject some of our lime to the gases, and in that case make chloride of lime."

The decision was to make the flag sixteen feet long and nine feet nine inches wide, so that each stripe would be nine inches wide. The blue field would be five feet wide and seven feet long.

This was certainly a task, and the boys were directed to prepare four strips of red and three strips of white, each nine feet long, and also three strips of white and three strips of red sixteen

feet long. Four of the short strips and three of the long strips were then laid aside to be dyed red. The other strips were put out to bleach.

When all this was prepared George was troubled about the colors.

"Professor, I do not see what we can use to make the blue and red colors."

"I think we are fortunate in having one of the varieties of the madder plant all about here."

"Is that a good dye plant?"

"It is a plant that is more extensively used for dyeing than any other in the world. For many years, until the products from petroleum began to come in, it was the only source for the red colors, because of its permanence. The dye is so powerful that it will turn the bones of animals red, if they are fed on it, and it also colors the claws and beaks of birds."

"Have you seen any of it here?"

"There is plenty of it growing here. You cannot mistake it. It is the plant with the elongated, smooth-edged leaf, which grows on the main stem, from which the small, thin stems branch out that carry the little red flowers."

"I know what you mean; let me get some of them at once." And George was off after the plant.

Meanwhile Harry was busily at work cutting out the double set of stars required for the blue field.

Several days before this George had prepared the roots of the chicory plant, as will be remembered, and it had been dried, and was ready to be ground up. At the noon meal he served the first cup of "coffee," to the delight of Harry, who was

completely taken by surprise, and afforded much amusement for George and the Professor.

"It seems to be rather strong," was Harry's only comment, "and even if it isn't real coffee, it is good enough, I assure you."

"Wouldn't it be injurious to take too much of it?"

"Exactly with this as with everything else. It is not the use, but the abuse, that causes trouble. Of course, chicory does not have the soothing and

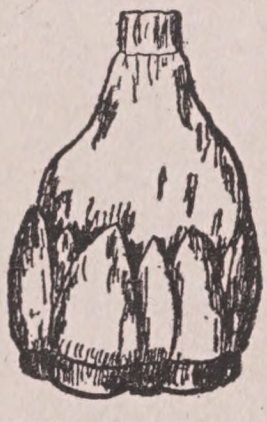


Fig. 33. Betel-Nut

hunger-staying qualities of the real coffee, but the bitter principle in the root is a tonic, and the extract is used as a medicine for that purpose. The leaves of the endive, of which we are using the roots, make a most delicious salad."

"Don't many people use this as a kind of an intoxicant?"

"If used to excess it has an exhilarating influence, on account of its tonic properties."

"I have often thought it was wonderful," said Harry, "that people all over the world have some

kind of a weed or plant that they use to stimulate themselves with."

"There seems to be a universal instinct in man to select the strong and bitter principles for that purpose. The aborigines of Central America used rolled tobacco leaves ages before Columbus was born; and the coca leaf, chewed by the lowest orders of the Peruvians, was for ages, and is now, their main source of strength and comfort. So opium, hemp and the betel-nut have been used by eastern Asiatics from the remotest antiquity; and the same is true of the pepper plants of the South Sea Islands and the Indian Archipelago; also of the thorn apples used among the natives of the Andes, and on the slopes of the Himalayas. In northern Europe the ledum and the hop have been so used, and in Siberia the narcotic fungus has been eaten from time immemorial."

At that moment Baby appeared on the scene, his hands and one side of his head dyed a beautiful red, presenting a ludicrous appearance. The first glance at him was one of astonishment; but realizing that he had been testing George's newly made dye, all burst out in laughter at the amusing sight.

"You really look like a red angel," was George's greeting, and Baby seemed to relish the joke. From that time forward Baby's name was "Red Angel," but it took him some time to learn what the new title was. It took him much longer to acquire it than it did to learn what honey meant.

"Red Angel is certainly a very smart little chap," said the Professor, with a laugh, "because

he was really doing what is done in the dyeing art and in chemistry every day, furnishing a test sample."

"Test sample; what is that?"

"In the art of dyeing it is the custom, before commencing to dye goods, to make a test sample, and all goods dyed must come up to the standard set by that sample. That is called the 'test sample.'"

"But how do the chemists use it?"

"In the analyses of chemicals one of the processes is by what is called the color metric test—that is, the test by color. The chemist makes a solution with a known quantity of the element in it which is of full strength and purity, and is therefore of a well-defined color. Now, if any substance is to be analyzed, the same reagent is used in the tested sample as was used to make the well-known sample. The color of the unknown sample is then compared with the known sample, and the quantity determined by the difference of color in the two."

"What do you mean by reagent?"

"A substance used to effect a chemical change in another substance. For instance, what is called Nessler's Reagent is a substance which, if put into water, will detect one part of ammonia in twenty million parts of water, and give a perceptible reddish-yellow tinge."

"Well, Red Angel has certainly made a good test sample for us; isn't that a good color?"

The blue color was still wanting when the other parts were ready, and the Professor came to the

laboratory with a sample of bitter-sweet, the common hedge plant of North America. The boys both recognized the plant and were surprised to learn that it contained a dye suitable for their purpose.

"We can use this or take some of the copper ore, that is, the blue vitriol part of the ore, and by putting it in a lime-water solution a beautiful blue color can be obtained."

The flag, when completed, was really a work of art. They gave many days to the task, and were proud of it. The question of a suitable pole or flagstaff was one which now absorbed their energies. As nothing of the kind was found in the immediate neighborhood, it was suggested that on their regular hunting day it should be made a part of their duty to find a staff worthy to be installed. The trips to the cave, and the absorbing work of preparing the flag, had so taken up the time, that they had entirely forgotten the regular outings.

On this occasion they insisted that the Professor should accompany them, and George declared that the only place available for a good pole would be in the forest below the South River, where they had shot the ocelots.

The yaks were prepared, as usual, and it was a merry party which started off on that bright morning for the forest. They did not, you may be sure, forget the spears and the guns, and before leaving home Harry thought it would be a good idea to provide a small two-wheeled truck, which could be used as a trailer, for the pole.

On the way down, Harry said: "How large a pole shall we get?"

George had his opinions, as usual: "Let us get a pole at least 50 feet long. We must have something which will match the flag."

"A pole that length will be a difficult matter to raise; have you thought of that?" was the Professor's observation.

"Can't we rig up something to raise it with?"

"Yes; and for a pole a hundred feet long, if necessary."

The Professor made no further objections. Reaching the South River the yaks were tethered, and taking advantage of the raft which they had used on the first trip, they were soon on the way into the forest. On this occasion they took a course to the right of their former exploits, the desire being to acquaint themselves, as much as possible, with the topography of the country toward the falls. Soon they came within sight of game, squirrels, woodchucks; and many familiar varieties of birds were seen on all sides.

What interested the boys most was an animal about three and a half feet long, and almost three feet high, which they saw at a distance.

"What is that, Professor?"

"It is a giant ant-eater, found in many parts of South America."

"What a big bushy tail he has."

"He uses that in a peculiar way. When he sleeps he lies on one side, rolls himself up so that his snout lies on his breast, places all his feet together, and covers himself with that bushy tail.

As the hair of the tail resembles hay, or the surrounding dried grass, it is likely to be passed by without being noticed."

"I wish we could get a shot at him."

"There is a fine pole," said Harry, whose keen interest was as great in that quarter as in the hunting.

Figure 34.

THE GIANT ANT-EATER

It was an exceptionally fine specimen of shell-bark hickory, and the base was nearly six inches in diameter, but it was as straight as a line, apparently, and it was fully thirty feet to the first limb.

"You couldn't get a better pole; but hickory is one of the heaviest woods, and being green, it will

be a task to raise it. It weighs, dry, about 45 pounds per cubic foot."

"What is the weight of a cubic foot of water?"

"About sixty-four pounds."

"How much do you think that pole will weigh when it is trimmed up?"

The Professor, after carefully surveying the tree for a time, answered: "It will weigh fully 400 pounds, but I am in favor of taking it, as we know shell bark is a good American tree, and it is the kind of wood we usually select on account of its strength. I know it will resist any winds likely to come our way."

It was at once cut down, and on measuring was found to be 58 feet up to the branching top, at which point it was not less than two inches in diameter.

"Cut it off above the last crotch, as we shall want that part to attach the top pulley between."

Now that it was cut and trimmed, the problem was to convey it back to the river.

"Do you think we can induce the yaks to swim across the river?"

"That's a capital idea, Harry; let us go back and try it."

"While you are getting the animals I shall do some investigating," said the Professor.

The boys crossed the river and took the two-wheeled truck across. "It might be amusing to the Professor, if he found we had taken the truck across before we knew whether the yaks could be induced to go over." Harry laughed at George,

and answered: "How shall we manage it? We had better keep them yoked, I suppose."

After some urging, they were driven to the water, the boys having tied a rope to the yoke before they went into the river. To their great surprise and relief, the yaks made no objections, and immediately started out at a great rate for the opposite shore, and before they had gone twenty feet were swimming. The boys in the raft held on tightly and were drawn across without further trouble.

As they left the river for the trip, they distinctly heard a shot.

"I wonder what the Professor has shot? Did you hear him?" They listened intently. The shot appeared to come from a point considerably to the left of the place where the pole had been cut, but they paid little attention to that. After they had gone halfway another shot was heard, this time at a point which indicated that the Professor must be some distance away.

As anticipated, the Professor was not in the location of the pole.

"I don't think the Professor expected us back so soon," was Harry's suggestion. "Let us rig up the pole and hitch the team, and by that time he may be back."

In less than a half hour this was done, ready for a start; still no signs of the Professor.

"I think we had better fire a shot to let him know we are here."

"Singular we didn't think of that before; here goes." Waiting fully a quarter of an hour after

the shot, they were surprised at not hearing any response from him. "I wonder," continued Harry, "if he has met with some accident?"

"We heard it in this direction, didn't we? Don't let us waste any more time. Get the guns and ammunition. Hurry up; and let us take a spear; it may be useful."

Each boy took a spear, as a matter of precaution, and set out. At intervals the boys shouted, and after wandering about for fully a half hour, determined to try another shot. This was answered by a shot apparently from the direction of the team, and the boys turned about and hurriedly made their way back.

It happened that the boys had actually lost their way, and in the excitement all sense of direction. The Professor had made a complete circle and the boys in their wanderings had executed a complete loop within that circle, and were actually going back to the river instead of to the team.

"I can't understand this business," said George, in a despairing tone. "We have traveled far enough to get back to the team twice over. Let's try another shot." It was answered by a shout from the Professor, close by, to their left, and when they appeared in sight he was seated on the log leisurely driving the yaks, laughing in a quiet way, and apparently not noticing the discomfiture of the boys.

"We thought you were lost," said George; "didn't you hear us firing?"

"How does it happen you are going in this direction?" was the Professor's quizzical remark, which

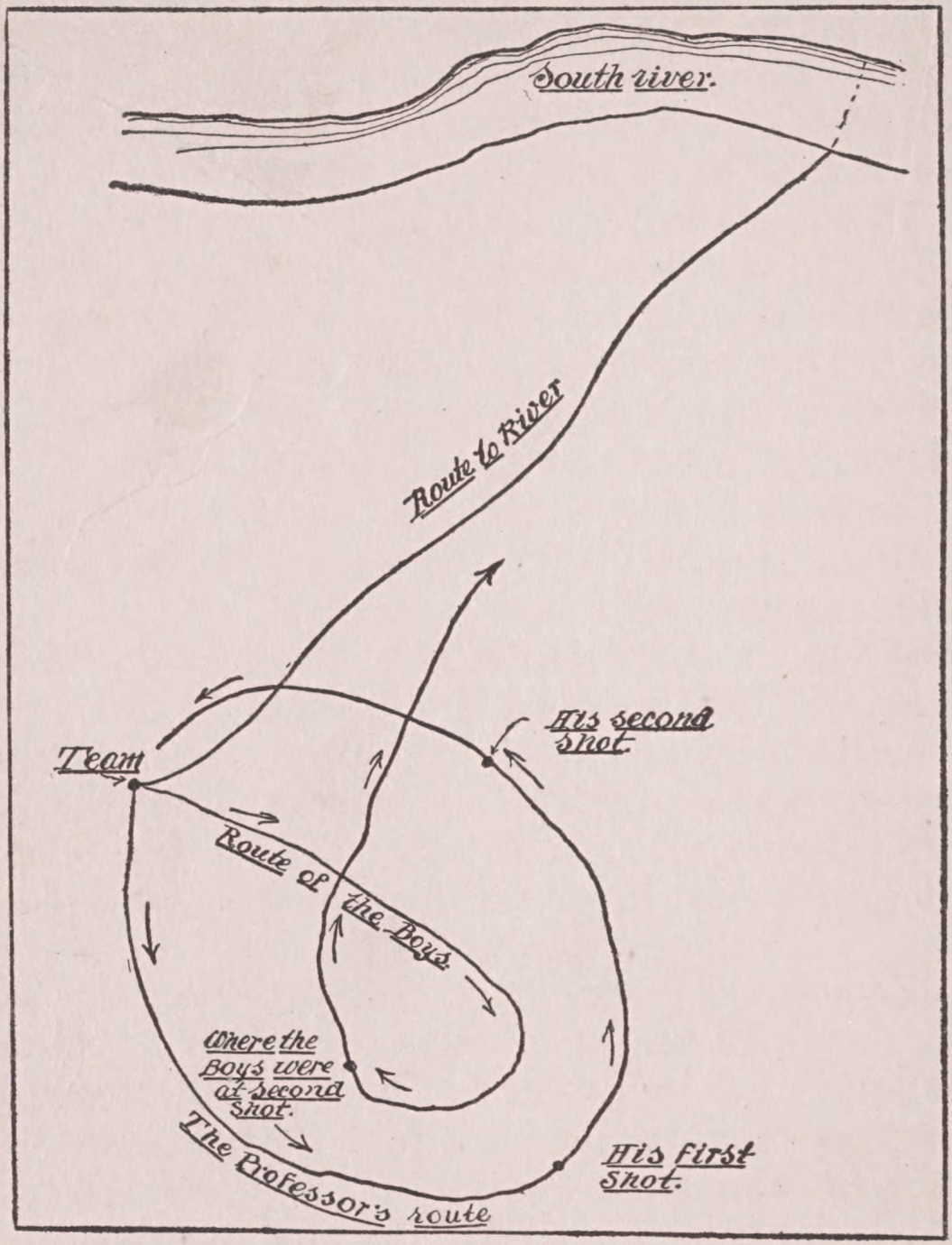


Fig. 35.

CHART SHOWING HOW THE BOYS WERE LOST

he uttered with a faint suspicion of a smile. As the boys did not reply, he continued: "Did you expect to find the team at the river?"

Of course, they all had a good laugh at this,

because the direction they were taking, and the position in which the Professor found them, were sufficient to indicate that they were really lost, and that he knew it.

"I felt satisfied," was his final remark, "that you had not a well-defined idea of your direction when you fired the last time, but you will learn in time how to keep your direction, and what is more, you will never again permit an excited condition of the mind to make you take a crooked path."

The boys looked wonderingly at the Professor.

"How," asked Harry, "does an excited mind make anyone take a crooked path?"

"When the mind is excited, it is, for the time, deranged, like soldiers, frequently on the field of battle, who are wounded, without having the least knowledge of it. The sense of direction is a well-developed trait in some people; in others, it does not exist at all. But in the case of either, the moment the mind is excited, it becomes abnormal; some lose the ability to judge distances, some are unable to talk, and others can't do anything but talk. All judgment for the time disappears. Now, take that person in a forest, and highly excite him, and he has absolutely no judgment of distance or direction, and is not in a good position to mark and follow a course with intelligence. I have spoken thus fully on the subject, in order to warn you, that under no circumstances should you ever set out on such a mission as you have with the least cloud of excitement. It is far better not to go at all."

It was a warning the boys never forgot.

CHAPTER XIV

THE RAISING OF THE FLAG AND ANGEL'S PART IN IT

On the return home that evening they were surprised to find Red Angel absent. Frequently he would go with them on their trips, but he was purposely left at home on this occasion. He had ample opportunity to roam at will during their absence, and had never strayed away.

"It is very singular he cannot be found. I searched the house, the shop, and the cattle range, and he is nowhere in sight."

It was a grief to all to miss him, as all had learned to appreciate his mischievous tricks, and George had taken a delight in "educating" him. Probably now, that he had grown to a more mature age, the spirit of the wild life possessed him, and he had taken French leave at the first opportunity.

George missed him more than Harry, because as cooking was one of George's accomplishments, and as honey was the weak spot in Red Angel, the kitchen was an attraction, and the reward for service in the kitchen was this delicious sweet.

Their stock of this was running low. George was not as liberal with honey of late, and after ruminating on the subject of the disappearance, he concluded that Red Angel had cause for "running away."

The next morning while at breakfast, who should appear at the door but Red Angel, his long fingers

and palms holding a quantity of nuts. He evidently saw that the welcome was most enthusiastic on the part of all. With the utmost gravity he shambled across the floor and deposited the nuts on the table and took his usual place in the most matter-of-fact way, and commenced on the nuts as though it was part of a solemn duty.

George's hand reached out for the honey; Angel saw it, a quizzical look came on his face—a real orang smile—and he forgot about the nuts.

In a spirit of fun George helped himself without offering any. This was too much for the animal, and with a shrewd, calculating look he pushed the nuts over to George.

Did he get any honey after this? George could not resist this appeal; and after Angel got it, and George helped himself to nuts, the Simian approval was very marked. Do you think he reasoned?

Preparations must now be made for "pole-raising day." In the absence of a sufficient amount of rope the last bearskin was cut up into strips, as it was necessary to have nearly a hundred feet, and the bearskin was a much-needed addition to the small quantity of ramie cord which they had on hand.

The Professor took a keen interest in the proceedings. "We must get a half dozen forked poles of good wood; they should be of different lengths, to support the pole as it goes up. Then, Harry, as we have a pretty tough job before us, I suggest that you make two capstans, something like those you saw on shipboard, around which the

two raising ropes can be wound, each to have a crank, and a means for holding the crank at any position."

The preparations occupied the greater part of the day. Several boards, five feet long, were required, and at least a dozen stakes to hold the capstans in position.

Early the following morning the yaks were brought out, yoked up, and the pole and truck

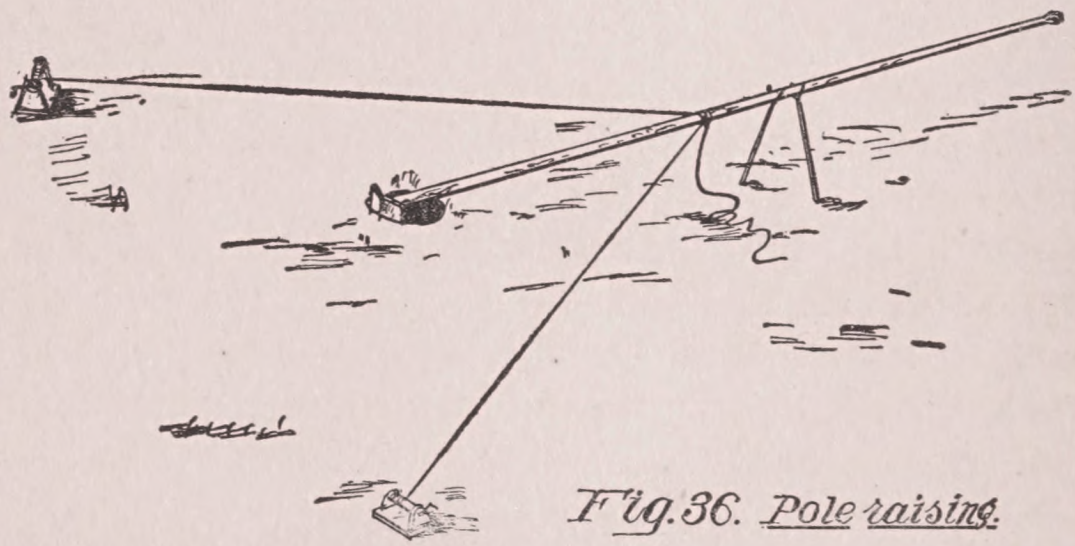


Fig. 36. Pole raising.

hitched on. A luncheon was provided, the flag and all paraphernalia assembled and loaded, and Red Angel invited to attend the ceremonies.

Reaching Observation Hill, a spot for the pole was selected, and a hole three feet in diameter and five feet deep was laboriously dug out. It was, indeed, a trying task, with the tools they had, but it was a labor of love. It was more than that to them. They were now making preparations to notify the world that they still lived.

The top of the pole had been provided with a pulley, which was mounted between the crotch, and

a guard put over the pulley, so it would prevent the halliards from coming off. When it had been placed in position, with the foot across the hole, the two boards were stood down in the pit so the end of the pole was against them. The halliards were then strung over the pulley and looped down, and the three ropes were attached to the pole, twenty feet from the lower end. Together they raised it up, so that it was about five feet from the ground at the point where the ropes were tied. Two of the ropes were then carried out past the hole, and branched out, and attached to the capstans, while the other was allowed to hang. As the capstans turned, the pole was gradually drawn up, and the Professor stood ready with the forked standards to prevent the flagstaff from falling back. In less than an hour it was erect, and the work of tamping in the dirt and stone around the base was in order, and soon completed.

And now for the flag!

"Tell us, Professor, why the attaching of the flag on the cord, or halliards, is called *bending* it?"

"The term comes from heraldry, and it originally designated two diagonal lines across the field of an escutcheon. Later on, sailors bent the ends of the flags or ensigns on the halliards, or around the yards, and also called the fastening of a cable to the anchor a bend; a knot is also designated by them as a bend; the form of the ship from the keel to the top of the side is called a bend, as, the midship bend."

A strong rope had been seamed in the end of

the flag, and eyelets worked at intervals, so that the task of attaching it to the halliards was soon performed.

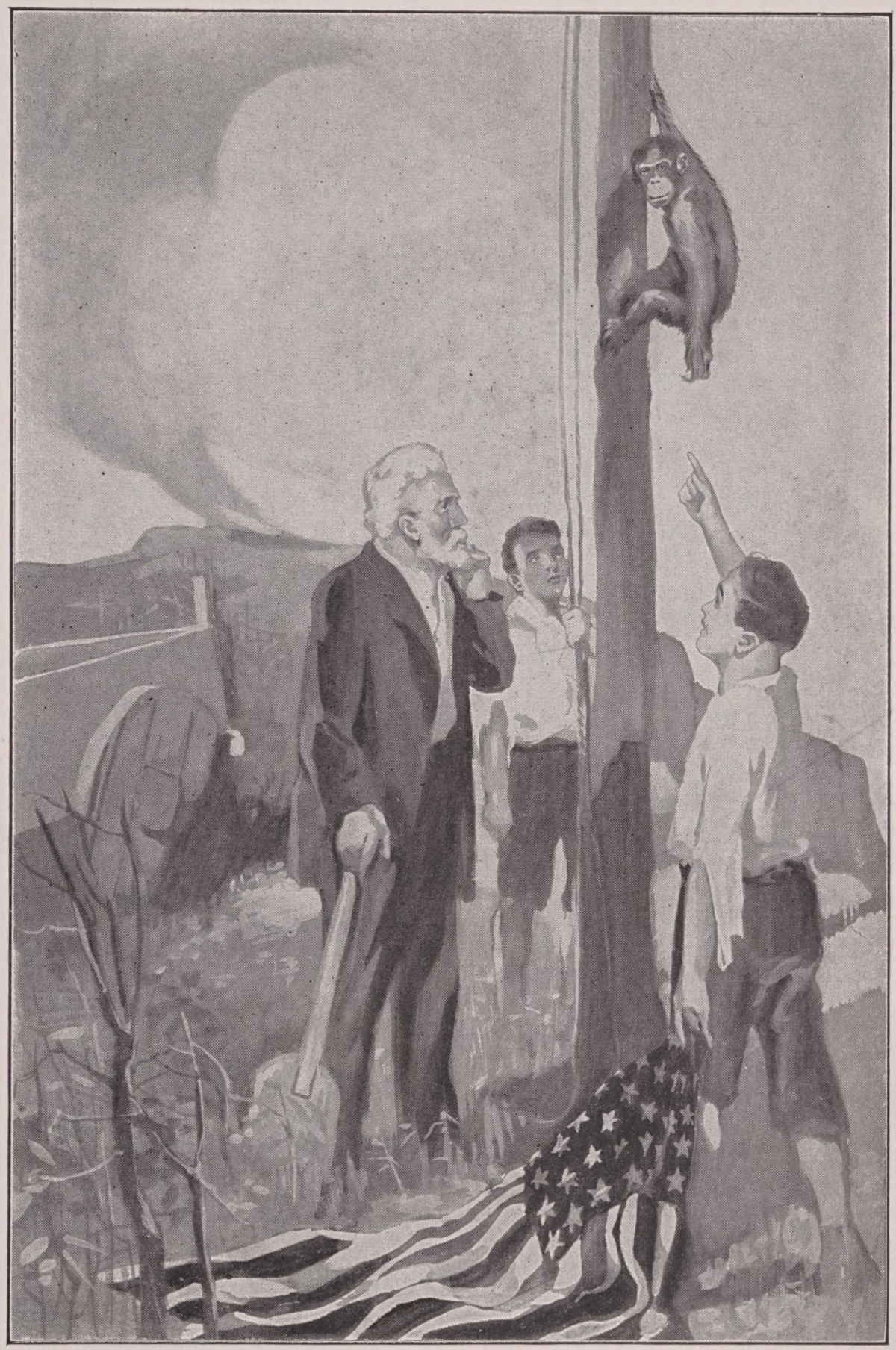
"The raising of the national emblem for the first time in any new country has always been regarded as an event of the greatest importance, as it represents sovereignty and responsibility. On this occasion," said the Professor, as he removed his hat, "let us honor the flag with appropriate ceremonies."

At that moment Red Angel concluded he would also take part, and in an instant was at the pole and scrambled upwardly. When the top was reached he caught sight of the wheel. It moved. Every time he grasped the rope the wheel would turn.

This seriously interrupted the program. The Professor could not help laughing. A moment before he was particularly grave, and the boys had no feelings of mirth; but now this new element in the proceedings added gaiety to the occasion.

"Come down, you rascal! Come down! Do you hear me?" cried George. Red Angel didn't hear. He hung there and smiled; yes, smiled, as he looked down, while playing with the wheel. "We can't put up the flag while he is there." George walked over to the wagon, and took out the honey pot. Red Angel saw it, but made no motion to come down. The honey pot was held up as an inducement, but there was nothing in the world so fascinating just then as that wheel.

Harry and the Professor laughed at the situ-



"Red Angel saw George's design, and without saying a word he slowly descended"

[See p. 183]

ation. Just to think of it! An orang-outan actually preventing a foreign power from hoisting the emblem of possession over his native land! It was too ludicrous for words.

George actually became almost hysterical as he threw himself back on the seat of the wagon and held up the honey pot, while laughing. "What do you think that little scamp has been doing? He has eaten every bit of the honey." That only added another fit of laughter, and when it subsided, and George could recover his voice, he added, "and wasn't this a smart thing to do?" as he held up the vessel.

"What?" asked Harry, momentarily straightening out his face.

"He actually put the lid back after he got through."

But this could not last indefinitely. No one suggested a remedy, if there was one. The United States must take possession in the proper way; hats must come off; the flag must go up slowly, and the band must play the national air;—the music, they had not thought of it before.

"Can you climb the pole, George?" asked the Professor.

"I think so, with the aid of the halliard."

He approached the pole. "Do you hear me, Baby, come down! Come down, I say!"

Red Angel saw George's design, and without saying a word he slowly descended, shambled over to the wagon, and hanging on the side of the box, looked around to the company in the most reproachful manner.

The hoisting of the flag was, indeed, a solemn thing, but it had its amusing side, and when, with uncovered heads, the flag went up to the masthead and stopped there, the Professor said: "We should have had music to make it more appropriate, but as we have no band, let us sing 'The Star-Spangled Banner.'"

The boys were both good singers, as the Professor knew. The song was started, but before the first line was finished, they broke down and tears began to come; the Professor, with his hands clasped and head bowed, did not look up, nor was he surprised when they stopped. The boys had a suspicion that even he could not have carried that song a single bar. They were powerless to go on.

When the Professor did look up and gaze on the flag, the boys saw his tears; they were ashamed no longer, and their eyes looked up, too.

In a voice which sounded almost strange to the boys, the Professor said: "We take possession of this land in the name of the United States of America, and give notice that we shall defend the same against all powers."

Then, as the beautiful flag unfurled itself, and threw its waving shadow on the ground that it now protected, they looked down, and there was Red Angel, close beside them, looking up at the flag as though he understood what it meant, and his silence gave consent to the solemn act which transferred his allegiance to a greater power.

As they were about to descend the hill the

Professor called them to a halt. "Do you intend to leave the flag at full mast?"

They had entirely forgotten to half mast it. "And now," said Harry, "if they can't see that flag we'll make one big enough next time."

As they went down the hill, they could not help looking back over and over, to admire the flag and the pole, and everything connected with it. They knew every thread and every piece of it. Somehow it seemed to be a part of them.

There was always a sentimental streak in George. "I can't help thinking that is the most beautiful flag in the world; I suppose other people think the same of their flag. How did flags come to be used by people?"

"The flag is the successor of the banner, which is taken from the Celtic word 'band.' The Bible mentions banners, showing they were used early in scriptural history. The banners of the Romans, used in their warfares, were essentially different from modern flags, colors and ensigns; they were carvings of wood or metal, some of them representing eagles, like the Persian standard described by Xenophon. In the Middle Ages it was a connecting link between the military and the clergy. The crescent and the cross symbols typified the two great contending forces of the world at that time."

Returning to their home, tired with the exertions, they sat in the living room and talked over the events of the day. Somehow, they felt that the day was too sacred to be desecrated with further toil. They congratulated each other at the

success in raising the pole, as that was a matter which had given them a great deal of concern.

Ever since the day on which they commenced work on the electric battery the boys deplored the lack of glass. If they could make that it would be of such immense importance to them in many ways. It would be of great service for their tableware; they could use it for their electric work, which interested them more than any branch to which their time had been given, among the mechanical arts; with that they could make thermometers and testing instruments; and give their house the air of a modern home, because windows could be put in.

"Will it be difficult to make glass?" asked George.

"It is an exceedingly simple matter to make glass—that is, to fuse or melt it. The difficult part is the art of making it, either by the blowing process, or by making the flat forms, like window panes and the like. Owing to the simplicity in preparing it, the making of glass articles was known at a very early date, certainly fifteen hundred years before the beginning of the Christian era. In the first stages only opaque glass was produced, and it was not until eight hundred years later that the first transparent product was manufactured. Under Pharaoh it was one of the products extensively made and exported to Phonecia and other Mediterranean ports. Five hundred years before Christ, Aristophanes mentions glass or crystal vessels, but as its value at that time was

next to gold it could not have been a common article."

"What is glass made of?"

"Simply common sand. Sand is the ground up particles of quartz, and may be found almost everywhere. The principal thing is to get the pure quartz. In connection an alkali of some kind must be used."

"What is an alkali?"

"A substance which is the exact opposite of an acid. Potash, soda and hartshorn (or ammonia) are the best known. They have most remarkable chemical activities, and an alkali united with an acid entirely neutralizes or destroys the activity of both. The compound produced by the union of an acid and an alkali is termed a salt."

"What is the effect of using an alkali with the quartz sand?"

"Quartz possesses all the qualities of an acid, so that when the alkali is fused with the quartz a neutral substance, unlike either, is formed."

"What kind of alkali is best to use?"

"That depends on what it is to be used for. Quartz and lime make a fine window glass product. Bottle glass is usually made of soda and quartz; window glass is also made of quartz, soda and lime; plate glass of quartz, lime, soda and potash; and flint glass has only the alkalis, potash and oxide of lead."

"Well, for our purposes, wouldn't it be better to make the glass out of quartz and lime if windows can be made out of it?"

"By all means, for several reasons: We have

the lime on hand, and also because it makes a very hard article."

"What can we melt it up in?"

"The clay retort or crucible will just be the thing for the purpose, and the first thing in the morning I will make a tour to a point close at hand, where I think we shall be able to get a good quality."

The boys were astir in the morning earlier than usual. They had a new impulse—something to learn and to do. Harry busied himself with putting the crucible in order, and in getting the fuel. George, after his usual morning's work, brought in the lime, and broke it up preparatory to grinding it up into small particles, so that it would intimately mix with the sand.

Within an hour the Professor returned with several samples of sand, either of which, he thought, would make a good article. The yaks were hitched up, and George went with him to get a good supply.

"How much do you think we ought to make up at first?"

"Several gallons of the sand will do for the experiment."

"What kind of article should be made with the first trial?"

"We might make some window glass. It is true it will not be transparent, but it will be translucent, and so will give us light, as well as though it should be transparent."

"What is translucent glass?"

"Where the surface of a cast plate is polished

the material is such that you can see through it, but if it is left rough it is impossible to see through it, although it will permit light to go through. The term applied to such glass is translucent."

"If light will pass through, why is it the eye cannot see through it?"

"A powerful magnifying glass shows that the surface of unpolished glass is formed by a layer of crystals, or of sand, with the faces projecting out in all directions and at all angles. The result is, that a beam of light from the eye strikes one or more of these faces and is diverted from a straight line through the glass. As all the rays are thus changed from a direct course, confusion results, and the eye distinguishes nothing."

Several bushels of the sand were brought to the laboratory, and the Professor then directed the preparation of a half dozen slate slabs, each slab being nearly two feet square. He explained that in practice iron plates were used, but as they had nothing of that kind available, slate would answer admirably.

"The slate slabs must be heated, and when the fused material is poured on the slabs, the heat must be kept up for a short time and gradually cooled down."

"What is the object in doing that?"

"If cooled too suddenly the plates will crack, but by heating the slates and then cooling them down gradually, we anneal the glass, in a measure. You remember how we annealed the steel by gradually cooling it down? Glass, however, cannot be

annealed so that it will not fracture, although attempts have been made for years to find a means for doing it. The man who can discover a process that will enable it to bend without breaking, can command any price for the discovery."

CHAPTER XV

MYSTERIOUS HAPPENINGS ON THE ISLAND

THE Professor supervised every part of the operation with the utmost care. "Before the plates are heated you must put a raised margin around each slate square, so the molten material will not run off."

"How high shall we make the margins?"

"About a quarter inch above the surface of the slate."

"As we are now ready to heat up the crucible, how shall the materials be mixed?"

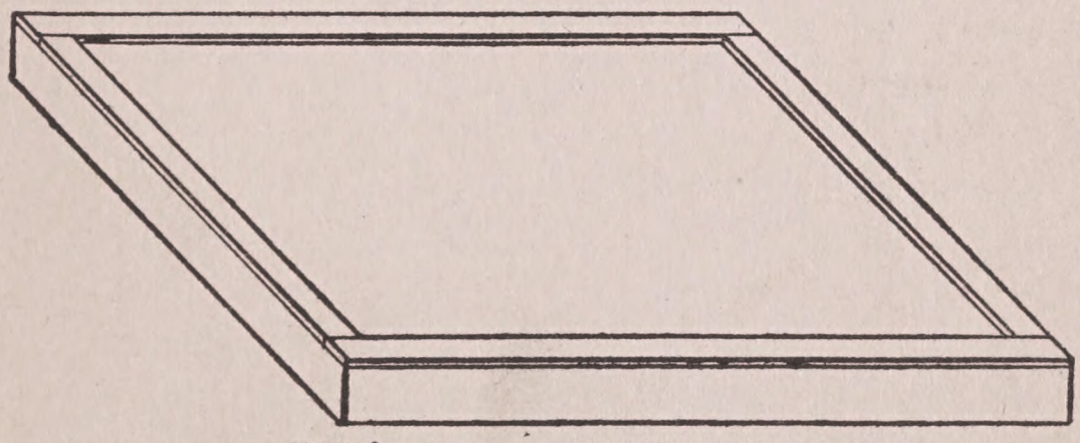


Fig. 37. Making Sheet Glass.

"For this trial, measure out eight quarts of sand and two quarts of the lime, and after depositing it in the crucible, we are ready for the heat."

In a short time, with the assistance of the blower, which has already been described, the sand

began to melt. It was now stirred so that the elements were thoroughly mingled. During the melting period the dross or impurities which came to the top were skimmed off, and when no more of the impurities collected the Professor stated that they might remove the crucible and pour the melted mass into small pockets, which they had previously formed with clay.

"Why not pour this on the slate forms we made?"

"Because we must know that we have a good sample of glass, and for the further reason that the product we are now to make should have some glass in it that has already been fluxed before, and we now have such a manufactured material."

The material which had been cast in the pockets was broken up with a hammer, as soon as it had cooled, and its appearance noted.

"I see we shall have to use less lime."

"Why?"

"You will note that it is too white or milky-like. This shows too much lime and consequently it is very brittle."

"Suppose, on the other hand, there was too little lime, what would be the result?"

"We should then have a glass which would not hang together at all. In the one case, as with the present sample, with too much lime in it, we have made a product which is closely allied to the alkaline base; and if we had, on the other hand, too little lime, we should have something which is nearly like quartz, hence not suitable for our purpose."

"It seems, then, we have to do in this case just as Red Angel did, make a test sample?"

"This allusion to their pet caused a smile all around.

Since the trip made by our colonists two months before they made no effort to gain any additional knowledge of their island. What they really knew of the country, aside from two of the trips made in the interior, under very unfavorable circumstances, was of no value as a means of locating the natives.

That the island was inhabited there could no longer be any reason to doubt. The fire plot on the banks of the Cataract River, the lights near the woods beyond the West River, the finding of the arrows, and the mysterious use of the boat which had so strangely disappeared from the falls in South River, to say nothing of the removal of the flag and flagstaff, were evidences which could not be disregarded.

The further investigations which they must make for their own safety was one of the impelling steps which determined them to build another boat. The discovery of the wrecked portion of the lifeboat and the decision to utilize the recovered portion for the new craft had facilitated their preparations somewhat, but there was still a great deal of work to do.

They had six imperfect guns, as they called them, mere pistols, muzzle-loaders, with barrels eight inches long, and the powder was not the best which could be made. Everything was crude and imperfect, and to boldly venture out among sav-

age tribes with such an equipment would not be wise.

All these things were considered in their conferences. But another matter was suggested by the Professor, which carried some weight. A sail had been seen by them. There could be no question on that point. Other ships might come again, and now that they had a flag of such proportions that it would be seen miles further than the original one, it was possible that the opportunity of rescue might be more likely from their side of the island than anywhere else.

It was certain that if a ship should, in their absence, reach the port, and even discover their home through the instrumentality of the evidence which they had left at the signal flag, there was no assurance that the vessel would await their return, or undertake the mission of rescuing them from the savages, if they should be so unfortunate as to be captured.

It was a most distracting thing to solve. It was not only perplexing, but exceedingly trying, to feel that at any moment a visit might be expected from the natives.

Nevertheless, after all considerations, and giving due weight to the likelihood that some ship might visit them, the building of the boat was decided on, and it was to be of such a character that it could circumnavigate the island. They believed it to be their first duty to do this.

This was the Professor's view: If we can build a boat large enough, and make it of sufficient strength to carry us and the provisions we must

take with us, on such a voyage, we should, at some point in our tour, find the natives, and determine their character."

"But, supposing, Professor, that they discover our boat and should pursue us?"

"My reply to that is, that our vessel must be made of sufficient size and strength to outsail them. My opinion is that the most they have is canoes, and we could readily cope with them. The difficulty is this: If we should be discovered, their curiosity, to say the least, would be sufficient to cause them to trail us along the shore, and it would be exceedingly uncomfortable to have them follow us around the shores to our home. Afloat, in strange localities, on an uncharted sea, at night, is a trying situation with a sailor, even though he has all the instruments of navigation at his command. To go ashore, under the circumstances, knowing that the savages are in wait, would be fully as dangerous."

To Harry's practical turn of mind, there was another feature that might be considered. "Some time ago you stated, Professor, that it was quite possible we had an island near us as a neighbor, and from which we may have had visitors. If such is likely to be the case, our boat will be the means of enabling us to reach that island, because if they have boats of sufficient size to come here they will be civilized, at any rate."

It will thus be seen from a consideration of all the conditions what determined them to increase the dimensions of the proposed new boat, although

it would consume more time than they had originally contemplated.

"Do you remember, boys, that it is now about one year since we left the harbor of New York on our voyage in the training ship *Investigator?*"

"Yes, and we have been on this island for nine months," answered George. "I can hardly believe it possible."

What might be called spring was now at hand, and as the warm rains had quickened the vegetation, the Professor suggested that it would be prudent to devote some time to the planting of such crops as could be utilized by them. Barley was a crop which grew in sufficient quantities all about them, so that no care need be taken in that direction.

Garden vegetables would be needed most. Wild potatoes grew in many places, but when they were needed search had to be made. Endives, which made excellent greens, could also be found, together with the cassava, and a variety of peas; but aside from the foregoing, nothing else was available.

While talking on this subject one day the Professor remarked: "In my wanderings I found quite a variety of plants that we might utilize in our proposed garden or farm. One of them is a small, triangularly formed, dark brown seed, which you may recognize."

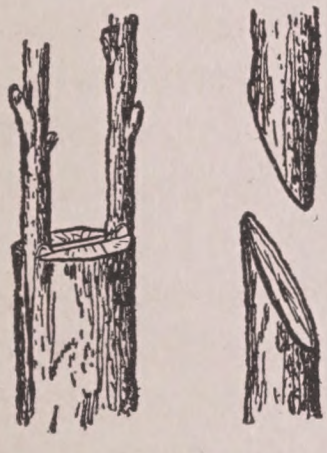
"That," was Harry's answer, "looks something like our buckwheat."

"You are right; I found several varieties; none of them exactly like the kind grown in the States,

but we can readily propagate it, so that it will be practically the same."

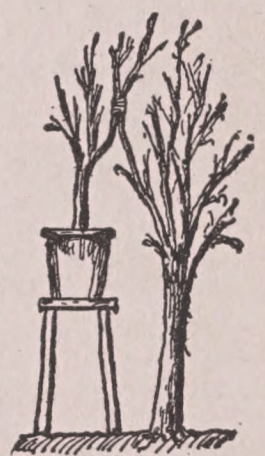
"How is the propagation done, so as to bring about the change?"

"It is merely a careful selection of the best varieties of the particular plant, and by budding, grafting, or inarching, transmitting the qualities of the good kind to the stalk or tree which bears the inferior kind. That is done with vegetation which is perennial, like fruit trees and the like."



Grafting.
Fig. 38

Budding
Fig. 39.



Inarching.
Fig. 40.

"But how could any of these methods be used with the buckwheat?"

"An entirely different method is used in cultivating vegetation of that kind. You probably have seen wild oats growing here, as in the States. In its wild or native state the grains are so small as to be utterly useless. It is found that by taking this wild plant and changing the soil in which it grows, the seed will finally develop and become larger, until, in time, we get the full grain. The

same thing is true in the development of fruit which is full of seeds. The banana in its wild state is full of seeds. By this process of cultivation it has finally become entirely seedless, and the value of the fruit greatly enhanced."

Beyond the Cataract was a low and level stretch of meadow, which the Professor thought was rich and could be readily worked, and it was the field which they determined to devote to agricultural purposes.

In the meantime, the plans for the boat were developed. A description of the recovered after part of the life-boat will make their plans better understood. When they landed on the rock, and its forward part was crushed and washed away, they saw the stern portion lodged in a saddle in the rocks. It was there for an instant only, as the next wave dislodged it, and when it was eventually found, months afterwards, it had caught in the rocks a hundred feet further inland.

The part which they recovered was still in a good condition, but the ruptured portion of the hull was a broken up and splintered mass, so that it would require considerable work to prepare it to receive the bow part which was now to be grafted on.

It had been originally sixteen feet long, with a five-foot beam. Harry's plan was to increase the new vessel to a length of twenty feet, and its extreme breadth six and a half feet, and in order to give greater security and carrying capacity, it should have a depth of two and a half feet.

"How much are you calculating on for the

weight to be carried on the new boat?" was the Professor's question.

"I am estimating that the passenger weight will be 400 pounds and the weight of the boat itself at 500 pounds."

"That is a very liberal estimate. Have you considered the mast and sails?"

"That is something entirely beyond my knowledge. I do not know what kind of sail; or how large it shall be; nor the length or size of the masts. If I knew something about the kinds of sails used for vessels I might be able to decide on that as well as the other parts."

"The term ship, as usually applied, has reference to a vessel furnished with a bowsprit and three masts—a mainmast, a foremast and a mizzenmast; and these three masts are each composed of three parts, namely, a lowermast, a topmast, and a topgallant mast."

"The bowsprit is that mast which projects forward from the bow, isn't it?"

"Yes. In small vessels the cutter and the sloop have single masts, the difference being that in the cutter the jib-boom has no stay to support it."

"What's the difference between the jib-boom and the bowsprit; they both project out from the bow of the vessel?"

"The bowsprit projects out only a little forward of the bow, and the jib-boom is attached to the forward end of the bowsprit."

"Well, if we are to have only one mast, should we have a bowsprit?"

"It is not necessary, for the reason that in a

small boat the boom, as it is called, to stretch the foot of the sail, runs out directly from the foot of the mast to which it is pivotally hinged."

"Then it would be better to have a single mast and a triangular sail, one side of the sail to be attached to the mast, and one of the other sides to the boom?"

"Yes; excepting that the sail must not be attached to the shaft, but to a cable which is run up the mast."

As the vessel was intended not for speed, but for safety and for ease of management, it was finally decided that the mast should be twenty feet long, and the boom sixteen feet, thus giving a sail area, approximately, of 150 square feet.

CHAPTER XVI

DISCOVERY OF THE SAVAGES' HUTS

While it was true that up to this time they had indirect evidence only of the existence of human beings on the island, several events occurred, at this time, which not only pointed more clearly to such a condition, but they began to feel that leaving the Cataract would be a hazardous thing.

The first incident occurred during one of the hunting expeditions in which the boys engaged. It had been their custom to penetrate the forest below the South River, not very far, it is true, but the sport there was most exhilarating to them after each week's work.

The Professor had always encouraged this. "You have not taken your usual weekly outing," he remarked, "and I feel we ought to have some wild game. If you have time, on your next trip, make it a point to explore the region to the south and west of the falls."

"That section interests me also," answered George. "I have often wished we could go down near the mountain range."

"Couldn't you go with us?" interposed Harry, "and let us make a day of it?"

"I should like to do so," he replied. "But I have good reason for declining at this time, on account of some special work which is attracting my atten-

tion, particularly in preparing the instruments we shall need on our voyage."

"That is true," answered George. "But we shall certainly start early enough in the morning to enable us to visit that section, and go far enough to get some idea of what it looks like near the mountain."

"It would be a good idea," suggested Harry, "to take the team along, as far as the river, at any rate, and that will give us an opportunity to ride going and coming. In that way it will help us."

"Yes; and to carry the game," said George, with a laugh.

"If you bag as big game as you did on the last trip, you will need the wagon," replied the Professor.

They were on the way early in the morning, with the guns and plenty of ammunition, and before nine o'clock reached the river. Scarcity of rains had considerably lowered the stream, and they discussed the advisability of fording the team across.

"I am in favor of the idea, if the stream isn't too deep. It seems to be shallow enough."

"Suppose, George, we take out the raft, and try the depth. If we find the animals will have to swim, we had better leave them on this side."

The raft was launched, and it was pushed out with the poles, but before going very far it was seen that the idea was impracticable, and it might be a hazardous operation.

"This won't do. Besides, we may not be able to go into the woods very far, in any event."

"Then," said Harry, "we must select a good place for the team, where they will be in reach of water, and cut plenty of feed for the yaks, as I can see a good half day's sport before us."

"I hope, Harry, we shall not make the mistake of getting lost this time. Let us keep the sun in mind, and watch our bearings at all times."

"The mountains to the south will always be a guide for us. Don't forget that. Then, we shall also know the river is to the north, or in the opposite direction from the mountains."

"So that we may know just where the team is, we must take a note of its location. See the four large trees near the other bank. I think we can remember them, and can see them for some distance."

The raft was pushed across the river, and when it had been properly secured, they began the march directly to the southwest, and within a half hour reached the border line of the great forest.

"Six months ago I would have dreaded to enter such a dense wood as this," said George.

"I was thinking of that, too," replied Harry. "Isn't it singular how we become used to dangers? This is fun now. I can never forget the first long trip we made through the forest to the west of the Cataract. I was frightened at every step, and started at the least noise."

As they entered, the underbrush grew thinner, but the trees were more massive and thicker, and they were so close together, in many places, that little sunlight found its way through the foliage.

"I would like to know, Harry, how we can tell

where the mountains are? The trees do not give us an opportunity."

"I suppose we shall have to depend on the sun altogether."

"Yes; it is now forenoon, and we must not forget that the shadow will point in a different direction in six hours from now."

"I have taken note of that," replied Harry. "We are now following our shadow, see? In six hours, which will be about four o'clock, which direction must we go to reach the wagon, judging by the shadow?"

"Let me see; the shadow is to the southwes now. At four this afternoon, it will be about southeast, so, I suppose, we shall have to take a course with the shadow at our right hand."

"Correct! I haven't forgotten that point about the shadows. It's really simple if you stop to reason it out."

Although numerous small animals appeared at frequent intervals, neither had an opportunity to try his skill, because up to that time the boys had been too intent on noting the direction of their route. The course was kept up due southwest, as planned.

"Did you ever see such a gloomy place?" remarked George. "If it wasn't for the chirping of the birds and the chatter of the little animals it would make me feel mighty lonely."

"Ah! there is something!" quietly whispered Harry, as he held out his arm, as though to restrain George. "See that animal slinking away?"

"Where?"

"Almost directly in front. Come closer. See that broken tree?"

"That's an ocelot," exclaimed George.

"Are you sure?"

"Just like the ones we got."

"Oh, this one's much larger."

"Shall we make a try for him?"

"Certainly; if we can get close enough," answered Harry.

The boys moved forward stealthily, using the most convenient trees to hide their movements. The animal was very wary, and the boys knew that the distance was too great to attempt a shot.

"Let us keep on after him. We may get a chance sooner or later," remarked Harry, eagerly.

But the animal kept beyond their reach, and after a half hour it finally forged ahead with such speed that it was soon lost to view, to the great disappointment of the hunters.

"Now, if we can get a glimpse of the sun we shall know what our direction is. This is the most wonderful forest I have ever seen."

"It seems to me we have gone considerably to the right. How far are we from the river, according to your calculations?"

"Well, Harry, I am not good at guessing, but I suppose we have traveled at a pretty lively rate while going after the ocelot. We certainly made two miles trailing him; and it was as much more from the river to the forest. I should say we are fully six miles from it."

"I wish we could get a glimpse of the mountains," answered Harry. "I wonder why the Pro-

fessor has always been so anxious to investigate this part of the island?"

"That is a mystery to me. It may be merely a natural curiosity."

The boys noted the gradual ascent they were making now, and it was also obvious that the trees were not so thick nor so tall, in comparison with those farther north.

"Do you suppose we are near the base of the mountain?" asked Harry.

"It must be we are near it, or we should not be going up so gradually, as we have done for the last hour."

When several more miles had been added, the woods thinned out perceptibly, and when the clearing was sufficient to enable them to get the first glimpse to the south, Harry remarked:

"Well, there are the mountains, and they seem as far away as when we left the river. Suppose we follow this ridge to the west. You see, there is another forest between us and the mountains."

As they advanced the trees were smaller, and there was every evidence that this was a young forest. There was an abundance of the finest grass, and here they found immense flocks of beautiful pheasants and numerous other birds that were unknown to the boys, and it was not long until they had more than a dozen of different varieties.

"This is getting to be a pretty heavy load," remarked Harry. "I think it would be a good plan to find a place for the game, and then come back and take it as we return."

"Yes; we ought to do that. What time do you suppose it is?"

"It must be past noon, and I am pretty hungry. Why not take our luncheon now?"

"Good idea. Look over to the right. It seems pretty clear there, and the two large trees there will make a good point to aim for on our way back. We can use the log there to rest and spread out our luncheon on," remarked George, as he pointed to the direction of the trees.

He kept looking in that direction intently, as Harry watched him. "What do you see?" Harry asked.

"That looks like a hut."

"So it does," replied Harry, excitedly. "It may be only a large rock, however," he continued.

"No; it doesn't look like a rock to me. Let us move up closer."

The object was fully a thousand feet away, and on a slight crest with few trees about. It was round-topped, very uneven in its outline, which gave it the appearance of a large boulder.

The boys approached cautiously, and as they came nearer, another but smaller object of the same character was noticed to the left.

"That is surely a hut of some kind. See the door at the side of the one to the left?"

"You may be right, Harry, but this seems to be an out-of-the-way place for a village or habitation. You know the Professor stated on one occasion, that even savages were smart enough to plan their homes near running water, and why they should select this place, when they could

easily find plenty of water not far away, is something I can't understand."

"Dead sure there is nobody here now. Look at the vines growing across the door opening. Isn't this a find? I wish the Professor could see this."

"Better wait wishing until we see it. We might find something that will surprise us."

"All right, George; let us get up, closer; I am anxious to see the door of the big hut. Let us go around to the other side."

Without approaching the clearing which extended out a considerable distance from the huts, the boys made a circle, until the open door of the large one was in sight, and they were, therefore, directly behind the smaller hut.

"Now let us go up behind this one. If there is anybody in the large one we can easily see him," quietly remarked Harry.

The weeds all about indicated that no one was living there at the time, but they were still too far from the main structure to be able to judge positively.

"What's this?" asked George, kicking at some broad-leaved specimens of vegetables. "See, they are in rows. Some one has had a garden here; that is sure."

"This is certainly getting to be interesting. No; I don't believe there is any one about. Still I don't like the idea of going up to that big hut with the open door."

The boys looked at each other inquiringly. The question was, what to do and how to do it.

"Suppose we fire a shot; that ought to arouse them."

"That would be a good idea, Harry, but I hate to waste the shot. We might call, and see if we can get an answer."

The plan was adopted and after each "Hello!" a slight answering echo came back. There was no response, and they boldly marched up to the open doorway.

There was no light within, other than that through the door, except a little streak from an opening, due to the partially decayed coating of the hut. There was sufficient light, however, to show that this had been occupied by people who were very primitive, as in the interior, at one side, was a pile of bones, scattered about, and a few broken clay vessels, as well as several clam shells, which had been ground to a cutting edge, the examination of which caused the boys to smile.

"Well, what do you think of this? Nothing but bones and dirt everywhere. I suppose it must have been occupied by the savages."

The large hut was circular in form, not exceeding twelve or fifteen feet in diameter, and its extreme height was probably eight feet. It was built of a framework of saplings, the thickest of them not exceeding two inches in diameter, which had been planted in the earth, and then had the tops bent over and bound together.

Smaller branches, or withes, were then run around and interlaced, so as to make the web fairly close, and over this was plastered a species of blue clay, which, when dried and baked by the

sun, formed an impervious coating that kept out the rain.

The boys marveled at the construction, because this was the first example of savage architecture they had seen. The smaller hut was distant about fifty feet, similarly made, but smaller in diameter.

"Let us examine the other place. Possibly that will give us some clue," and Harry started across the intervening space, while George was still rummaging about, uncovering the odds and ends and raking them toward the door.

Before Harry reached the hut, George cried out: "Come here, Harry; I have found something." And he held up a scrap of paper. "If the savages have been here they have left something that looks like writing."

Harry was back in an instant, and leaned over George's shoulder as he tried to make out the scrawls on the piece of blackened and crumpled sheet which he was smoothing out. The paper was about four by six inches in size, and evidently a good quality of wrapping paper, known as manilla.

"There are words here, sure enough. Look at this—it must be a name. Yes; can you read it? 'Rogers.' But who has signed it? Can you make that out?"

"Well, if there is one scrap, the chances are there must be some more. Let us get this stuff out of here."

"But be careful, Harry. I found this by the merest accident, and as it is, you will see I have torn it."

A more careful search was now begun, and every scrap was raked out and examined. A brass button was among the things; a buckle; the broken blade of a knife; a little metal disk, which might have been part of a locket case; a steel ring, all rusted and about two inches in diameter.

As these things were successively brought to light, it dawned on the boys that this might well have been the homes of savages, and the articles mentioned were likely taken from captives. The message on the paper, if it could be deciphered, might be the most valuable clue, but they were reserving that for examination later on, when they could have the assistance of the Professor.

The important thing now was to go over every bit of material in both places, and then make a survey of the surrounding country. It set at doubt all questions in their minds about the inhabitants of the country.

The small hut was visited, and here the litter was still more profuse, but after every scrap had been gone over, there was nothing to add to the small accumulation which they had taken from the other hut.

"Shall we go any farther?" asked George.

"It seems to me that this is enough for one day. Before going back, however, let us look all around this place. You know the Professor will be sure to want to know everything about it."

Directly west of the knoll, on which the huts were situated, was a slight declivity. "Let us go down the hill for several hundred feet," said

George, as he led the way through the tangled brush.

Within a hundred feet of the hut was a little brook, with the clearest cold water. "I can see why the huts were placed there. Look at that spring."

Within fifty feet of their position was a slightly shelving rock, and below it a bubbling spring flowing upwardly into a semicircular basin formed in the rock.

George ran forward and made a quick survey. "Here is a metal drinking cup, just as they left it. My, but it's heavy!"

"I wonder what it is made of? Here, rub it."

Only a few passes were made over it, when he held it up in astonishment. "Why, it looks like silver."

"So it does," broke in Harry. "But what is this on the side? See those initials: 'A.W.'"

"I must have a drink before I leave this," and Harry removed the little copper cup which he always carried. "What a peculiar water this is! It must be a kind of mineral water."

"Yes," responded George; "that is sulphur water, or it has considerable sulphur in it."

"I wonder if this was a health resort for the savages?" asked Harry, as he laughed.

"Let's start for home at once," remarked George, without noticing Harry's sarcastic fling at the poor inhabitants.

CHAPTER XVII

THE GRIM EVIDENCE IN THE HILLS

The boys secured a convenient pole, over which they slung the braces of game, and started out on the march for the river. It was fully three o'clock before they were ready to start.

"See here, Harry, there is something we have forgotten, and I begin to feel it now."

"What is that?"

"Our luncheon."

"I was so excited and interested that I forgot all about it until now. Why not go back to the spring and take luncheon there?"

"With that water? I'd rather wait until we get to the river."

"Well, let's take something, anyhow. I am mighty hungry. Funny we didn't think of it before."

"Now for our direction. Do you think we can strike the river at the right place?"

"I'll be perfectly satisfied if we strike the river anywhere."

"Then why not go directly north, and we can reach it a mile or two sooner than the way we are now going."

"Good idea! Here we go!"

It was a lucky thing that they decided to take a different course from the river, because they soon discovered that the ridge they were on ran for a

long distance almost directly north, and that the woods were not nearly so dense as they were in the course they had followed.

At frequent intervals they came upon new game, and brought down a number of additional specimens, until Harry protested against any further stopping.

"It seems to me we have enough to last a week, and it is getting mighty heavy at this end of the pole."

"Well, it does seem to be an awful distance over to the river. Are you sure we aren't mixed up in the direction?"

"Of course not. The mountains are right behind us, and the shadow at our right. You can't fool me the second time," answered Harry, as he shifted the pole to the other shoulder.

While thus talking they caught the first glimpse of the river, and it was hailed with delight.

"Whenever I get near the old river it feels like home. My! how I would like to put in several days in a further hunt over toward the mountains. I am sure we would turn up something there."

They reached the river a considerable distance above the falls, and without stopping to rest, went down along the bank for a full hour before they came within hearing of the rushing water.

They sat down on the craggy rocks alongside of the stream and took a good rest. "This will be interesting news for the Professor," said George, musingly, as he watched the rushing stream.

"Indeed, it will. I should not be surprised to find that the natives are directly south of us, or rather west of the mountains."

"That may account for the fact that they have never been near our part of the island."

When they took up the load to resume the journey, it was still heavier, apparently, than before, and they were now so thoroughly tired that frequent stops were made, but in another hour they had the satisfaction of seeing the large trees that had been singled out for their guidance.

It was a great relief to deposit the load on the raft, and it did not take long to swing the raft under the wagon and start the yaks on the homeward journey. The Cataract came in sight before six in the evening, and the Professor was on hand to welcome them.

"Did you have a good time?" he inquired; but as he looked over the tailboard and saw the fruit of the hunt, exclaimed: "You must have gotten everything over there."

"Yes, and something else besides that," said Harry in such a tone that the Professor anxiously asked:

"What; have you made any discoveries?"

"Look at that," replied George, as he carefully drew out the discolored paper with the writing on it. "We not only found this, but we discovered some huts—two of them, fully six miles or more southwest of the falls."

The Professor's eyes opened wide. "This is, indeed, interesting. But never mind about telling me now. Let us get the team unhitched and ex-

amine this when we get inside. I had a suspicion that the other side of the river would give us some clue."

While Harry and the Professor were putting up the team George prepared several of the pheasants for the evening meal, and they were soon in the oven. By common consent the meal was of more importance than the new finds, and when the dishes were removed the paper was carefully examined.

"If I knew just what was used for the writing, I might suggest something that would bring it out more clearly. It is evident that the writer did not use ink."

"Why do you think so?"

"Simply for the reason that this name, Rogers, which is the most plainly written, has the words only on the surface of the paper. If ink had been used it would have penetrated the fiber, and the writing would thus have been preserved."

"Where did you find the paper?"

"It was among a mass of rubbish, which, on account of the poor light, was raked out to a point nearer the door, so we could examine the material better, and I don't know whether it was with the pile of bones or with the stuff on the other side."

"Was the grass about the hut as high as the grass round about the place?"

"It seemed to be. We made a pretty careful examination all over, so as to give us a fair idea of the condition of things."

"How far was the spring from the hut?"

"Less than a hundred feet."

"By the way," remarked Harry, "we forgot

to say that close to the small hut we found some vegetables growing in several rows, and weeds all over the place and between the vegetables."

"Do you think," asked George, "that the vegetable garden is any sign that white people have been living there?"

"It may be; but the lowest savages have usually some form of knowledge about raising and caring for vegetables, so we should not count too much on that. This cup here seems to indicate the presence of some civilized being, whoever he may be."

"It is just as likely, is it not, that the savages may have captured a prisoner who had the cup?"

"That is one solution. This writing is the most important piece of information we have had up to this time. It is not at all likely that the natives would preserve it, so that the only conclusion I can draw from it is, that the one who wrote the message, or the one who got the paper, was at the hut, and now the important thing is to arrive at some sort of idea *when,* and what the message means."

"It does not seem," remarked Harry, as he carefully scanned the paper, "that we can make out more than a few of the words. Here is the word which looks like 'river.' Yes; I am sure of that."

"And besides that the words 'of' and a capital letter 'B,' and something that looks like 'r-e-n,' which may be simply part of a word," added George.

"As this is simply ordinary wrapping paper, it is likely that it may have no meaning whatever. Still, I have been trying to recall whether anyone

on shipboard had a name that these initials would fit. My limited knowledge in that direction does not help me, I confess."

"What do you suppose the cup is made of?"

"That is undoubtedly silver, or some alloy of metals of which silver is the principal part. It is very hard, as you notice. It is certainly a singular thing that a vessel of this kind should be left at the springs, if the owner of it was there, and it is just as remarkable that the natives would permit it to remain there. I now regard the finding of the cup as of far more importance than the paper, because of these considerations."

"Well, the finding of the huts, and these articles, are pretty strong arguments in favor of our purpose to find the people who owned the things we found there," responded Harry.

"But I have also a little news to impart," said the Professor.

"What is it?" asked the boys in concert.

"I have found a companion to the skeleton we discovered on the beach, and also some information about the inhabitants of the island."

"Tell us about it. Where did you come across it?"

"It isn't much of a story; but an hour or so after you left, I felt like taking a little stroll, so I crossed the valley east of us, and skirted the incline beyond, going toward the cliffs fronting the sea. Ever since we found the skeleton I felt that, unless washed out to sea, there might be some other traces of the wreck.

"I was quite unprepared to make any searches

along the hillside, except for evidences of minerals, and particularly to note the peculiar outcropping of the rock on this side of the ridge which terminates at Observation Hill.

"The backbone of the ridge is limestone, and after I had reached a certain level I noted, all along, that the rock had remarkably wide cleavages; that is where there had been breaks in the rock the seams opened, and in some places I found recesses fully six feet wide, and thus caverns, sometimes thirty or forty feet in length, would be formed.

"I explored some of them in the hope that it would lead me to a cave of some extent, but in this I was disappointed. Such may be the case, but I have not discovered anything which leads me to believe that there are other caves than the one we explored.

"I entered one of those, which was a long way this side of Observation point, and there, on a rude sort of improvised wooden cot, was a skeleton. I found a half dozen arrows, lying near, but neither a bow nor any other kind of weapon was anywhere in sight.

"The skeleton showed that it was the remains of a tall man, past middle age, undoubtedly, and there was no evidence that he came to his death by any wound which effected a fracture of any of his bones. The cot on which the skeleton reposed was made of pieces of wood, in a complete state of decay, and there was not a vestige of clothing, jewelry or pocket articles at or near the bones.

"I found two of the arrows near one hand, and

the others lying about. Here they are. Handle them carefully, as they are decayed, and will readily fall to pieces, unless you use the utmost care. That is my story. I hunted all about the vicinity, hoping that I might find some additional clues, but I was disappointed."

"Do you think he had any connection with the skeleton we found on shore?"

"No; it does not seem likely. My reason for saying so is, that it would take several years for wood to decay, as you see in the case of these arrows, and the cot had the heaviest portions all rotted. In my opinion this skeleton shows greater age."

"Under conditions of that kind, what sort of story could you weave out of it, so as to determine what happened to him?"

"It is decidedly more interesting than our adventure, and about as difficult to gather any information from," answered Harry.

"In my opinion, the man died from starvation, as you say he had no tools or implements of any kind," replied George.

"That may be; but it appears entirely different to me. The man was, undoubtedly, cast ashore, or was shipwrecked. We have evidence that this island is noted for taking in people that way. He may or he may not have had clothing, but in either event, he could not starve in a place like this, with vegetation around him everywhere and at all seasons of the year.

"I am picturing this condition of affairs in my mind: He was, no doubt, out in quest of food,

when he was attacked by the natives and escaped from them. He was wounded by them, and when he reached his shelter, removed the arrows, as I found them near his bones. It is probable that his wounds proved fatal shortly after he reached the cave."

"But how do you account for the cot on which he was lying?"

"It would be the most natural thing for him to find a place to shelter himself. That would be the first thing to do; just as he had a place to retreat to, and was fortunate enough to elude his pursuers, who were not aware of the hiding place."

"That seems reasonable," remarked George. "But it seems to point one way sure; that we have a pretty tough lot of people on the island to deal with, and satisfies me that we are going about it the right way, in making the proper preparations for the time when we must meet them."

CHAPTER XVIII

STRANGE DISCOVERY OF A COMPANION LIFEBOAT

The greatest activity was now manifested in every direction. The Professor was here, there and everywhere, taking part in every sort of labor which the different work required. Part of the time he was in the meadow where George was engaged in plowing up an acre of ground for the garden.

It must not be concluded for one moment, that the scheme of eventually leaving the island had been forgotten and that their preparation for planting crops foreboded an indefinite stay.

It will be recalled that the Professor knew what idleness and an unoccupied mind would do to the boys in their situation. He tried in many insidious ways to stimulate the boys to think out and carry forward original work, and in almost every instance he succeeded in doing this in such a way that the boys themselves suggested the work to be done.

Harry was the builder, and the utilizer of the knowledge gained, and George was content at the arrangement which kept him in the workshop with the tools, while he gladly did the most of the outdoor duties.

For two weeks the boys worked without a thought of relaxation, and on this occasion, as on many others, it was incumbent on the Professor

to suggest a day of sport. It was the only direction in which he at any time tried to wield the energies of the boys, and from this you may infer how intensely they were interested in the marvelous developments day by day, of which they were the important factors.

"Well," said Harry, "I must confess that I had entirely forgotten our arrangement to devote a day each week to hunting and explorations, and I didn't miss it."

"Nor did I," was George's reply: "I suppose we shall have to go, as I imagine the Professor wants to have some sport," and he laughed at the sly dig which he had given him.

The Professor smiled. "You are right, George, old as I am, I am in for sport, and fun of any kind. Why, I am just as young as you are in feeling and desires, but the difficulty is that getting old is a habit with many people. It gets on their nerves; they get some reminder of old age every day of their lives, and sometimes hourly during the day. When this goes on for three, four, five or ten years, it is too much for the most of humanity. It is taken as an accepted fact that old age means infirmity, and the break comes, not really because the body is weak and worn out, but because the mental state has contributed too much to the idea that they are no longer young and cannot be youthful, and are getting too old to enjoy things that others delight in."

The all-absorbing topic at the evening conference was to determine where the hunting exploits should next take place; whether to the west, where

they had witnessed the fight between the bears for the honey tree, or to the other side of the South River, which they called their hunting preserves.

Heretofore, George had been anxious to do all the hunting along the river, but now he kept suggesting the forest to the west, and it eventually turned out that the real reason was on account of the supply of honey giving out; and he had an idea that, as they had not seen any trees with honey indications anywhere else, in their wanderings, that would be the proper place to go.

His views prevailed, but it was a two-days' journey, there and back. That was the only objection; and considering that they had not taken a vacation for two weeks, this was not an extraordinary thing to do, notwithstanding the urgent work which they had started on the boat and in the agricultural line.

The next morning the yaks were yoked, the wagons supplied with their usual camping equipment, tools, weapons, provisions and the like, and a start was made before ten o'clock.

By agreement a course was marked out farther south than was taken on their previous trips, because they had never explored the country immediately north of the South River, except beyond the falls, and it was their aim to learn every foot of the territory.

On their way they passed the mysterious hole where George had his experience, and the route was also close to the spot where Harry found him when he was lost. Both places were again visited, so that samples of rock might be taken from

one of the places, and the Professor hoped the clay bed on the small creek might indicate the proximity of other metals than they had been able to find previously.

Late that evening they reached the edge of the main forest, and a camp made for the night. Red Angel was with them. He was as happy at the sight of the forest as an orang well could be. It was his delight to exhibit his skill as a climber on these occasions, and where the woods were dense he would spring from limb to limb with surprising agility.

During the night, as on several previous trips, Angel exhibited his nervousness, which was attributed to the presence of some animal that alarmed him, but otherwise nothing disturbed the camp.

"How far do you think we are from the falls?" asked Harry.

The Professor made a mental calculation as he replied: "We cannot be far east of it; possibly five or ten miles at most, and it is very likely several miles south. Since you suggest it, we might deviate from our route and take it in, as to do so will not take up more than two hours of our time. It interests me because I have not examined the place from which our boat was taken. That is one of the mysteries I am most interested in."

George was anxious to get a solution of that singular occurrence and jumped at the opportunity to go there. A southwesterly course was at once marked out, and after traveling about three hours George's alert ear caught a sound, as he was

at that time leading the advance. Running back he called out: "Do you hear that peculiar sound?"

The wagon stopped. In the stillness around them they could hear a faint murmuring sound.

"Do you know what that is?" The boys looked at each other. "I think," continued the Professor, "that must be the falls."

"Then why not turn to the left and go directly to the river?"

They did so, and within fifteen minutes the river was in sight. A further trip of ten minutes brought them to the foot of the falls, where the boat had been deposited nearly five months before and which had so mysteriously disappeared, only to be recovered by them and again lost by accident, as detailed.

A search along the river bank failed to reveal any trace of the tree overhanging the stream, where the oars had been placed, and instead the river washed out a small bay. All along the banks were evidences of washouts which piled up driftwood every place along the shore where there was a root or snag which would hold the accumulations. The Professor wandered down the stream, pulling out and examining pieces of the limbs, to find, if possible, whether there were any evidences of the drift having been cut by human agencies.

So far as could be seen, the limbs had all been broken, not cut, and this was a relief, in a sense. The South River drained a large part of the island, and it might rightly be inferred that the driftwood in a stream of this kind, if it flowed

through a region inhabited by man, would show some signs which they might interpret.

As they were returning George pointed across the river at a peculiarly shaped log, or what appeared to be portion of a large tree. The river at this point was about seventy-five feet wide. The Professor was silent for some time. "My eyesight is not of the best, but it does not look to me like a tree."

"I can easily swim the stream," and Harry had his clothing off in short order, and plunged in. Gaining the other side, he drew himself up, and without touching a thing in and about the debris, called out excitedly: "It is a boat, something like our lifeboat! Yes; it is exactly like our boat!"

"Can you dislodge it? If not, I'll come over."

"Never mind, I can manage it, I think."

The interior of the boat was filled with accumulated material of all sorts, principally leaves and bark, and when it had been lightened of all that weight Harry put his shoulder against the stern and soon succeeded in dislodging it from its seat against the tree which held it a prisoner.

Just before he had it in a position to launch the Professor called out: "Don't put it in the water until you have found something which will serve as a paddle." The stream at this point, being less than a half mile below the falls, had a fairly good current, so that without an oar of some kind he would not be able readily to get it across.

"I can't find any signs of oars, so I will take a piece of this wood."

He ferried it across, and landed a hundred feet

below. As he neared the shore George sprang toward it excitedly, and cried out: "Look at that! See the name, 'Investigator'!"

Harry stopped rowing, and bent over the side of the craft; there, plainly, near the stern, was the word "Investigator" followed by the letter "L." The space beyond the letter L was broken, and if anything else had originally been in that space it had been brushed off by contact with some outside object.

This was, undoubtedly, one of the companion lifeboats of their ill-fated ship.

"How do you suppose this boat ever got here?"

"It undoubtedly came over the falls, and if so, it must have come from the interior of the island. My only solution is, that our companions in this boat were also, like us, cast ashore, or, at any rate, the boat itself was, and if they reached land safely probably used this boat on the river."

"Isn't it singular that this boat has been treated just as our boat was, since they removed the lockers? Why should they do that?"

"The interesting thing to me is," answered the Professor, "why the boat was lost by them, if it ever was in the possession of our friends on the island?"

"Possibly the natives may have captured or killed them."

"That is a plausible explanation, but there may be a reason which is entirely different from anything which now occurs to us. I believe a search of the island will show that we are not the only white people living here, and that the loss of the

boat indicates that they are not on friendly terms with the natives."

All thoughts of hunting were now dissipated. It did not interest them in the least.

They sat down and debated the discovery. Undoubtedly, it had drifted down South River and gone over the falls, as the indented sides and bottom of the boat plainly showed. How far had the river carried it before the falls were reached? It was a matter of regret now that they had passed up the river before the animal trail in their path had caused them to leave it, instead of trying to discover its source.

Something must be done. Their companions must be in peril. That was a situation hinted at by the Professor. They had a duty to perform, if such should turn out to be the case. With many misgivings they decided that they must follow up the stream, cost what it might. No provision had been made for a lengthy trip, but, fortunately, they had plenty of ammunition, and as to food, they could supplement what they had by forage along the way, as they had often done before.

"What shall we do with the boat?"

"Let us find a place for it far enough from the shore to be beyond reach of the river, and hide it, so there will be no further danger of its disappearance."

"We are so used to have things get away from us that it has become a habit," said Harry, laughing.

While they were engaged in the task of drawing the boat up, Red Angel appeared, excitedly

chattering and endeavoring to attract their attention, and frequently running back in the direction of the wagon.

"What is the matter with him? I never saw him with such antics before." George, who had the greatest control over him, ran up and tried to catch him, but the little fellow avoided capture, and whenever George would get near he would spring toward the wagon, keeping up his excited gesticulations all the while.

The Professor now ran forward without another word, and Harry stood there wondering what had happened, or was about to happen. As he ran past George, who was still trying to get Angel, the Professor merely said: "He is trying to get you to go to the wagon."

The boys understood, and both started on a run. Harry was the first to get there. The team had disappeared!

Their further adventures on the island are related in the next book, entitled "The Mysteries of the Caverns."

GLOSSARY OF WORDS

USED IN TEXT

Absorb.	To take into; or to take up into itself.
Accomplishment.	Fulfillment; completion; perfection.
Accumulation.	Adding to; to bring together.
Acquired.	To take; the act of getting anything.
Activities.	Exertion of energy; action.
Adjacent.	Close to; near the object referred to.
Affinity.	Any natural feeling, drawing, liking, inclination, or affection for another.
Agility.	Quick; sprightly.
Agitated.	Excited; much perturbed.
Albumen.	The chief substance in an egg. The nutritive material within a seed.
Alkali.	Any substance that will neutralize an acid.
Allegiance.	An obligation of fidelity that an individual owes.
Allied.	Attached to; bound to; an arrangement with.
Allusion.	Referred to; to speak of.
Alternative.	First one and then the other, and so on.
Altitude.	The height; the top; the high part.
Ammonia.	A colorless, pungent, suffocating gas, found in small quantities in the air and in mineral waters.
Analyzed.	To separate; to find the principal parts of anything.
Anticipated.	Looking forward to the future; to expect; to forecast.
Antics.	Grotesque; ridiculous, fantastic action, prank or caper.
Appendage.	Belonging to; to hang or attach to.
Approximating.	Close to; in the neighborhood of.
Aquatic.	Pertaining to water; as a water (aquatic) animal.
Arbitrary.	Stubborn; determination to do, whether right or wrong.
Astringent.	Having, as a sour fruit or acid, the power to contract or draw together.
Atmosphere.	The air we breathe; composed of four parts of nitrogen and one part of oxygen, principally.

Attributed. Belonging to; to assign; refer, as an effect to a cause.

Bacteria. A microscopic microbe, very minute, widely distributed in all matter.

Base Line. A term used to designate a starting point for surveyors, or for builders in laying out work.

Battery. Usually applied to a series of cells for generating or storing electricity.

Bleaching. The process for whitening any substance, either by the action of the sun or by chemicals.

Bovine. Pertaining to the common cow species.

Calisaya. A weed which has a bitter principle from which a variety of quinine is extracted.

Camphor. A white, volatile, tough, gum-like, translucent substance, with a peculiar pungent taste and smell.

Carbon. One of the four principal elements. Coke; charcoal.

Carbonic acid. A heavy, colorless, incombustible gas.

Carbonize. To put in the form of a coke or charcoal.

Ceremonies. A formal act, rite, or observance, either religious or otherwise.

Charcoal. Wood from which the lighter or more volatile gases have been abstracted by heat.

Charged. Referring to a battery, or cell, which has been supplied with liquid; or anything filled with material.

Chicory. A product, used as a substitute for or an adulterant of coffee, containing a bitter principle, and made from the root of the endive and other similar plants.

Circuiting. The term applied to the wiring of a battery or other electrical apparatus.

Clarified. Liquid which has been relieved of floating matter.

Coke. Coal from which the most volatile gases have been taken by heat.

Conspicuous. Very plain; easily observed.

Cortege. A train of equipages at a funeral.

Contracted. Something brought down, or compressed into a smaller bulk.

Coagulated. Changing the form of solid matter in liquids.

Comprises. That of which any article is made up.

Conclusive. A finality; the end.

Constipated. A morbid condition of the bowels.

Concerted. Acting together, or in unison.

Contingency. The awaiting of an event; in the event of.

Corrosive. The action, usually of an acid, like rust.

Complicated. Mixed up; difficult to understand.

Compressible. That which may be put into a smaller compass.

Coincidence. One fact happening with another, or at the same time.

Commotion. In an uproar; not in order.

Compound. Made up of two or more substances.

Crenate. Scalloped or toothed by even, rounded notches.

Crenelated. Furnished with flutes and indentations.

Crucible. A receptacle for melting ores and the like.

Critically. In a low state; very ill; the danger point.

Crater. An open cavity of a volcano.

Crystal. Glass; transparent substances which are rigid.

Cubic. A body having six sides.

Curtailed. Cut off; only a part of.

Dentate. Tooth-like; made somewhat in the form of a tooth.

Density. The substance; the body, or the weight.

Dehaired. Material, like hides, from which the hair has been removed.

Debris. Accumulation of material.

Devoid. Left without; having nothing.

Devious. In a roundabout way.

Delicacies. Anything which is a luxury; that tastes well.

Decreasing. Growing less.

Dejection. Downcast; not happy.

Discrimination. Capacity to judge; to be able to pick out; to act well.

Discomfiture. Routed; disappointment; defeat.

Distracting. To turn aside for something claiming attention.

Dissipated. To scatter or to fritter away.

Dilemma. A quandary; difficult position or thing to judge or consider.

Diagonally. Going across corners. The longest distance across, starting from a base.

Discordant. Not in tune; not agreeable; not in harmony with.

Disinfectant. Any substance which will destroy germs or purify air, water, or foods.

Dross. The refuse; the impurities in a substance.

Domain. The country, nation, or the particular area or district owned by an individual.

Dynamo. A machine for generating electricity.

Elude. To evade the search of; to avoid pursuit.

Elongated. Made longer than normally, or greater in one direction than in another.

Enumerate. To take note of; to number.

Endive. A salad, well known here and in Europe; the root produces the well-known chicory substance.

Enhanced. Made better; put into a more advantageous condition.

Emitted. To give out; like the rays from a light; or blown out from the mouth or nostrils.

Escutcheon. The shield or helmet of a warrior, or the ensign of a house or family.

Essential. The particular thing; the important element.

Essence. The extract or the principal element in a substance.

Eventually. Finally; at the last.

Evolved. Taken out of; brought forth; made from something else.

Exhausted. Entirely removed; drawn off; reduced.

Exultant. Joyfully; rejoicing greatly.

Exerted. Making every effort; straining.

Exhilarating. A lively, pleasing or enlivening sensation.

Facility. With ease; readily accomplished.

Fantastic. A peculiar or abnormal condition.

Fermentation. A chemical condition where germs are developed and grow in a substance and change the elements comprising it.

Filament. A thread-like element, usually made of carbon and employed in the exhausted electric bulb.

Fissures. The openings, cleavages, or splits in rock or other formations.

Flail. An article formerly used for threshing out grain.

Flux. A substance used in connection with welding of melting liquids to facilitate the process.

Formation. The term applied to the manner in which rock, ores, or other geological substances are united or arranged.

Frantically. Excessive excitement from anger or otherwise.

Friction. The rubbing together of substances. Contact.

Fulcrum. The pivotal point.

Fused. Melting of ores or metals.

Gaseous. Any substance which is neither a solid nor a liquid.

Gelatin. A transparent, tasteless substance obtained from animal tissue.

Generated. To evolve from; to make; to originate.

Gesticulation. The making of motions, especially when excited.

Germs. An original element; the first form.

Geological. That which pertains to the study of the structure of the earth.

Glutin. Similar to gelatin; the nutritious element of wheat.

Glaize. The coating of a hard, flint-like film on pottery.

Gravity. The attraction of mass for mass.

Halliards. The ropes for holding a flag or banner.

Harmonize. To be brought into unison with.

Horizon. The point where the earth and sky meet.

Horizontal. Level. The surface of water is horizontal.
Hysterically. An uncontrollable laughter.
Identically. The same; similar to.
Illuminating. To light up; to make brighter.
Immoderately. More than usual; beyond the ordinary.
Immemorial. From very ancient times.
Imperfect. Not in the best condition.
Impetuous. Hastily; without considering consequences.
Impulse. A sudden mental motion or feeling.
Insecurity. Not sure of safety.
Intervening. Placed between; something between.
Instrumentality. By the agency of; by means of which it is accomplished.
Insidious. Doing or planning a thing without the knowledge of the victim.
Intact. Unbroken; whole; in good condition.
Instinct. A knowledge which comes from the internal senses.
Interval. Not continuous; having spaces or periods between.
Indented. To cut into or to notch.
Intimately. Closely associated; friendly.
Irrigating. To cover the ground with moisture by artificial methods.
Infectious. Transmitting diseases by passing from one to another; catching.
Identified. Pointed out; knowledge from some mark or otherwise.
Incandescent. Heated up so that it has illuminating qualities.
Innumerable. Without number. A large quantity; a great many.
Lavished. Given out without stint; liberal.
Laboratory. A workshop; a testing room; experimental works.
Leavened. The term used to indicate the raising of dough.
Lentils. A kind of greens, largely used in Europe.
Lumbering. Clumsily; huge; encumbered by bulk.
Ludicrous. Amusing; calculated to amuse.
Luxuries. Extravagant indulgences in pleasures.
Mineralogical. Pertaining to mines, ores, and similar arts.
Manifest. Made known; acknowledged; understood.
Neutralize. Made unlike either; the effect of uniting an acid and an alkali.
Nitrogen. One of the four principal elements. The lightest of all substances.
Nutrition. Food; the substance which is required for the sustenance of plants or animals.
Observant. Noticing; seeing; taking note of.
Obstructions. In the way of; impediments.

Octave. Composed of eight. A musical measure or scale.

Odor. The quality in a substance which renders its presence known by the smell.

Ominous. Of the nature of or marked by some omen.

Orifice. A hole; an opening.

Organisms. A body or substance that is in a proper condition for growth or development.

Oxygen. One of the four principal elements. One-fifth of air and one-third of water is oxygen.

Paralysis. Loss of ability to control muscular motion.

Parlance. A mode of speech; a phrase; a particular sentence.

Perceived. Noticed; observed.

Perplexity. Puzzling; distracted.

Petals. One of the leaves, or the subordinate part of the leaf.

Persistent. Firm and resolved.

Pelts. The skin of an animal with the hair on.

Perspective. The art or theory of representing by a drawing made on a flat surface so it will appear as not lying in that surface.

Perceptible. Noticeable; able to be seen.

Perennial. Not planted each year. Wheat is sown each year. An apple tree grows on from year to year.

Permanence. Something that keeps on or continues.

Pitch. The inclination, as the roof of a house; a high or a low musical tone.

Plateau. A rather level elevated portion of ground.

Plausible. Appearing to be true; likelihood.

Philosopher. One who seeks first truths; the underlying principles.

Phosphorus. A non-metallic element which readily absorbs oxygen from the air, and exhibits a glow by slow combustion.

Port. A haven. A home for a ship.

Potter's Wheel. A horizontal wheel revolving on a vertical spindle on which pottery forms are made.

Primary. First. Applied to a form of electric battery which generates a current by means of metals and liquids.

Precipitate. Throwing down, as applied to chemistry; causing the solid matter in a liquid to go to the bottom.

Prudence. Care; caution; ability to look out for the future.

Prosperity. Success in business; doing well.

Precede. To go before; the one ahead.

Primitive. The first way of doing things; the original plan or method.

Precaution. Taking care; going slowly and with caution.

Propagate. To bring to a better condition or state. Making an improved breed or type from plants or animals.

Projecting. Throwing or casting a shadow.
Proximity. Close to; in the neighborhood.
Phenomenon. Any new development; a startling sight; a natural occurrence out of the ordinary.
Puncture. To cut; to open; to tear.
Pyramid. A solid with a broad base and a top with an apex.
Quartz. The hardest of the common minerals. A common rock.
Rabies. A disease the germs of which are carried by animals when in a certain diseased condition.
Ramie. A very important fibrous plant; for making rope and many articles of fabric.
Retort. A heated furnace for the melting of ores and metals.
Rejoinder. An answer; a reply.
Relative. In comparison with; proportionally.
Registered. Taking note of; to keep account of.
Replenished. Taking new supply; a new helping.
Restrained. To hold back; to prevent.
Reservoir. A tank or vessel to hold liquids or other matter.
Reassuring. To restore boldness or courage; to make certain.
Reconciled. To bring content and to restore confidence.
Regulation. In accordance with some law or order established.
Reagent. A substance used chemically which will have an action on one or more substances in the sample treated.
Relaxation. A change from the ordinary routine.
Sanitary. Healthful; in a condition to preserve health.
Sarcophagus. A stone burial place, carved out of rock.
Scientific. That which has a reason and a knowledge for each step.
Serviceable. That which is of use; advantageous.
Seismograph. An instrument by means of which shocks in the movement of the earth's crust may be registered.
Septic. Any substance that promotes putrefaction.
Sewage. The waste matter carried off from cities by the drains.
Serrate. Formed with saw-teeth.
Sentimental. Involving or exciting the feelings or tender emotions.
Sequence. That which follows.
Shuffling. Awkward or clumsy movements.
Shambled. A shuffling gait, allied to clumsy movements.
Solution. To make out a problem; in chemistry, the unity of two or more elements which will mix.
Speculative. Opposed to practical or experimental; taking a risk.
Specter. A ghost; an apparition; a vision.
Sulphurous. From sulphur; having the qualities of sulphur.

Stimulating. To rouse to activity or action.
Sutures. The saw-teeth united portions of the skull.
Substitute. Taken for or instead of something else.
Subsided. Going down; quieted.
Subterranean. Beneath the sea; below the waves.
Sulphate. Sulphur united with any alkali to form a salt.
Symptoms. Indications; the appearances which indicate certain diseases.
Technically. Specially pertaining to some formal training in art, science or manufacture.
Theoretically. Pertaining to knowledge which is not exact, but in the nature of speculation.
Torso. The body, devoid of its limbs; the trunk.
Translucent. Capable of permitting light to pass through, but through which vision cannot pass.
Transparent. Any substance through which the eye can see.
Transversely. Across, at right angles. In the direction of the narrow way.
Transporting. Carrying; taking from place to place.
Theorist. One who speculates; one who tries to arrange facts to harmonize.
Triangular. Bounded by three sides, and which has three points.
Tubular. Like a pipe; a body with a hole through it.
Typical. A sample; a pattern; an emblem.
Utilize. To take advantage of; to turn to practical account.
Undeveloped. Not fully grown; not developed.
Unobtrusive. Not willingly thrust forward.
Vacuum. A space entirely devoid of matter.
Vanquished. Overcome; subdued.
Vestige. A visible trace, mark or impression.
Versed. Knowledge in a certain direction.
Vibration. Moving to and fro; a regular movement.
Veteran. One long trained in any service.
Voluntarily. Done of free will.
Vitrify. Converted into glass, wholly or in part.
Weird. Superstitious; uncanny; unearthly.

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